The AMSAT® Journal

Volume 40, Number 6 November/December 2017

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Fox-1B/AO-91 Now Operational

[Courtesy: NASA]

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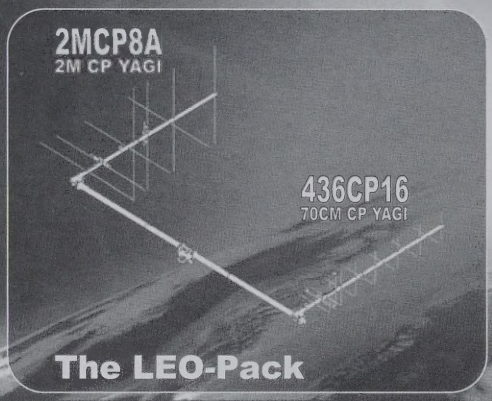

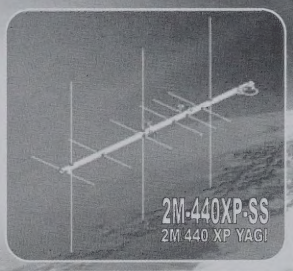

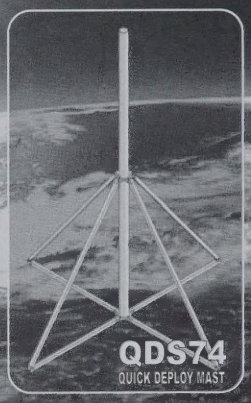

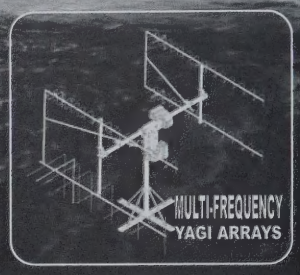

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**See our review, QST March 2016 page 60.*

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The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec) by AMSAT-NA, 10605 Concord St., Suite 304, Kensington, MD 20895-2526. Telephone: 301-822-4376, fax: 301-822-4371. Periodicals postage paid at Kensington, MD and additional mailing offices.

Postmaster: Send address changes to The AMSAT Journal, 10605 Concord St., Suite 304, Kensington, MD 20895-2526.
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Apogee View

Joe Spier, K6WAO
President

As Radio Amateur Satellite Corporation (AMSAT) approaches its Golden Jubilee, I want to introduce myself to all AMSAT members. At the recent Board of Director's (board) meeting in Reno, Nevada, I was elected President of AMSAT.

Founded in 1969, AMSAT is an all-volunteer organization (the only exception is our office manager, a paid employee) that has been instrumental in "keeping amateur radio in space" over the past 48 years. I can truly say this is a humbling honor, not only being asked to assume the command of the organization but also having to "step up" as Barry Baines, WD4ASW, our now Immediate Past President retires. Barry served as AMSAT President for the past nine years, through the initial CubeSat generation of Fox satellites. With Fox-1A (AO-85) already launched, the upcoming launches of RadFxSat, Fox-1Cliff, 1-D, and RadFxSat2 truly will be part of Barry's leadership legacy as President.

As one of my good friend's three-year-old granddaughter said this past summer before meeting me, "What's a Joe?" I am simply an amateur radio operator, K6WAO, formerly KF6JQF. First licensed 20 years ago, I now have my Amateur Extra class license. I also have FCC Commercial licenses, and I'm a Life Member of AMSAT. Professionally, I've been a specialist, technician, supervisor, staff aide, systems engineer, instructor, engineer, and RF designer. For AMSAT, I've been an Associate Director, Director, Vice-President, Executive Vice President, and now President.

One essential quality I bring to this new-to-me position is a passion for what I do. I serve at the discretion of the board for a one-year term, extendable each year at the Annual General Meeting. The board has ensured that I have one of the best teams of executive officers available to the organization. Paul Stoetzer, N8HM, will serve as the Executive Vice President, and Clayton Coleman, W5PFG, as Secretary. Keith Baker, KB1SF, will continue as Treasurer, with Jerry Buxton, N0JY, continuing as Vice President for Engineering. Drew Glasbrenner, KO4MA, and Frank Bauer, KA3HDO, will continue as Vice Presidents for Operations and Human Spaceflight, respectively. Gould Smith, WA4SXM, has agreed to continue as Director of Field Operations.

The AMSAT Symposium in Reno was well received by the attendees, with guests from as far as the Philippines, U.K., and Germany. I discussed the state of the organization, noting that the financial situation has improved slightly, but that daily operational costs still exceed revenue. The bottom line is AMSAT must find efficient ways of doing business to continue keeping amateur radio in space. A continued evaluation of our Strategic Planning Goals is needed to discover where we are successful and where we need to improve performance. If you missed the Symposium, a few Symposium Proceedings books are still available on the AMSAT Store.

Jerry Buxton's report on the Fox CubeSat news focused on the launch of RadFxSat (Fox-1B). After several launch scrubs, RadFxSat finally lifted off from Vandenburg Air Force Base on November 18th. Maurizio Balducci, IV3RYQ, in Cervignano del Fruili, Italy, was the first to receive and upload telemetry showing that the satellite was healthy. Shortly thereafter, Fox-1B was designated AO-91 and is now operational. I hope for the success of the mission and long life to our newest satellite!

Fox-1Cliff and Fox-1D are scheduled to launch before Summer 2018 from our partners at Spaceflight. In fact, Fox-1D was integrated into its Innovative Solutions in Space QuadPack for delivery to India. Fox-1D will launch on the next ISRO Polar Satellite Launch Vehicle (PSLV) flight, scheduled to take place by the end of December. RadFxSat2 is also scheduled to launch before the end of 2018.

The board has assigned me as president to work on developing several policies this year. Two policies are high on the agenda. The first concerns the creation of an AMSAT Scholarship to allow two or three students to attend Hamvention or the AMSAT Space Symposium and General Meeting. The formation of the general rules and

procedures for the scholarship are in the preliminary stages, but the initial idea is to grant scholarships for Engineering and a scholarship for Educational Relations, with those scholarships to be awarded on merit. We hope to have the policy developed within the next few months. I want to thank Michelle Thompson, W5NYV, for the initial idea for the scholarship program.

The second policy development regards the International Treaty for Arms Reduction/ Export Administration Regulations or ITAR/EAR. AMSAT needs to create this policy to protect our engineers and partners working on leading-edge satellite telecommunications projects. The policy will include a methodology to verify U.S. citizenship and provide compliance guidelines for our engineers and partners working on satellite projects. No ground-based projects should be affected at this time. A small team has been formed to undertake policy recommendations and legal review. While having a well-developed policy is always an exercise in due diligence, in my opinion, the real solution is for U.S. policymakers to exempt experimenters and perhaps even CubeSat builders from these regulations.

Amateur Radio on the International Space Station (ARISS) has completed the Phase 0/1 Safety Certification for the Multi-Voltage Power Supply (MVPS) but still needs to raise an additional $150k to provide the Inter-Operable Radio System (IORS) to the ISS. By performing the safety certification itself, ARISS saved approximately $100k that would have been needed to hire an outside contractor to perform the certification. Watch for upcoming fundraiser announcements, and please contribute what you're able to afford. With the many projects and contacts on-going, the ARISS team met in Rome for the ARISS-I Face-to-Face Conference. They met with the AMSAT-UK and AMSAT-DL teams at the AMSAT-UK Colloquium the following week to work on a European Space Agency (ESA) proposal for a Deep Space Gateway. While at Milton Keynes in the United Kingdom, Frank Bauer, KA3HDO, was presented with the Ron Broadbent, G3AAJ, Trophy by our great friends in AMSAT-UK. Congratulations to Frank on an award-winning year.

I've saved the best news for last. In Reno, I had the pleasure to announce the next phase of a CubeSat program, Greater Orbit, Larger Footprint or "GOLF." The initial design will be GOLF-T, a 3U Technology Demonstrator CubeSat with deployable solar panels and an Attitude Determination and Control (ADAC) experiment. As an initial step in the GOLF program, the board approved the submission of a NASA CubeSat Launch Initiative proposal for the GOLF-T satellite project. The GOLF-T project will serve as a rapidly deployable Low Earth Orbit (LEO) testbed for technologies necessary for a successful CubeSat mission to a wide variety of orbits, including LEO, Medium Earth Orbit (MEO), Geosynchronous Orbit (GEO), Highly Elliptical Orbit (HEO), or beyond.

AMSAT-NA Vice-President Engineering Jerry Buxton, N0JY, explained the new project. "The GOLF-T project tees off the next phase of our CubeSat program. GOLF-T provides AMSAT hardware and knowledge for Attitude Determination and Control (ADAC) capability and the opportunity to develop a 3U spaceframe with deployable solar panels that can be used in LEO or HEO missions, two of the major systems required in future GOLF and HEO missions."

GOLF-T also provides the opportunity for rapid deployment and on-orbit testing of the AMSAT's Advanced Satellite Communications and Exploration of New Technology (ASCENT) program's technology. A radiation tolerant transponder and Integrated Housekeeping Unit (IHU) are two technologies that will lead the way for low cost commercial off-the-shelf (COTS) systems that can function in the MEO and HEO radiation environments. GOLF-T will also provide for the development of "Five and Dime" Field-Programmable Gate Array Software Defined Radio (FPGA SDR) transponders for use on a variety of missions and orbits.

I hope you are as excited as I am about the new developments in AMSAT. I encourage you to do your part, whether that's operating the satellites, giving AMSAT or ARISS support, or bringing dollars or members to our organization.

Engineering Update

Jerry Buxton, N0JY
Vice President, Engineering

As I went to Reno NV for the annual AMSAT Space Symposium and Board of Directors meeting, I posted a message on Facebook stating that I was going to try a little golf. Only a few insiders would have understood the reference. Unfortunately, many of my friends and family members who do play golf took it the wrong way!
Much to their disappointment but hopefully to the pleasure of AMSAT members, GOLF is the acronym for the next series of satellites and stands for Greater Orbit, Larger Footprint. Following the tradition of alphabetical/phonetic names for AMSAT satellite projects such as Echo (AO-51) and Fox (Fox-1A-E), G is the next letter and golf is the standard phonetic for that letter.

At the board of directors meeting, I presented a plan for a series of 3U CubeSats and a specific CubeSat project called GOLF-T, with the board approving both the program and the project.

GOLF-TEE (a name revision that I added later) will be submitted as a NASA CubeSat Launch Initiative (CSLI) proposal, and the design will include an Attitude Determination And Control (ADAC) system, AMSAT's first deployable solar panel design, and a new radiation fault tolerant IHU design. Of course, this is all attached to various amateur radios that will likely include a Fox-1E V/u linear transponder and a Software Designed Radio (SDR) Five and Dime system. Details will be coming out throughout the design process as systems are chosen to fit the power budget and spacecraft volume. The launch target is currently 4Q 2019.

The GOLF-TEE project is the first of an expected series of the 3U GOLF Program. Much as the Fox-1 Program produced five CubeSats, we plan to do multiple GOLF

CubeSats. GOLF is intended to provide the experience and expertise necessary to operate attitude control and possibly future propulsion for 3U CubeSats reaching higher orbits, including MEO and HEO.

A partnership agreement with Ragnarok Industries, with whom we partnered in the Heimdallr finals for the Cube Quest Challenge Lunar Derby (often referred to as CQC or Phase 5), brings us the opportunity to acquire, learn, and re-use an ADAC system. That experience will quickly advance that area of our knowledge and experience necessary for 3U higher orbit satellites.

More fun and new satellites lay ahead for both the AMSAT Engineering Teams and the AMSAT members. Stay tuned!

The Fox-1 series continued to roll out with the successful launch and subsequent commissioning of RadFxSat/Fox-1B as AO-91 on Thanksgiving Day. So far, AO-91 has been showing us that the hearing problem with AO-85 was indeed caused by the broken receive antenna and the resulting patchwork to get it replaced in time for launch. AO-91 is meeting the Fox-1 design expectation of being an EasySat, with HT contacts using only a whip antenna and power levels as low as 100 mW!

I delivered Fox-1D to Spaceflight, Inc., in Seattle on November 6 and, along with a few members of the Spaceflight team, integrated her into the Quadpack. Fox-1D is scheduled to be launched by the end of the year riding on a PSLV from India.

RadFxSat-2/Fox-1E is moving along with the flight model systems construction nearly completed. At this time we plan for environmental testing in January 2018, with completion at the end of January. The launch by Virgin Orbit is currently scheduled at the end of the first quarter of 2018, but personally, I expect that to slip a bit.

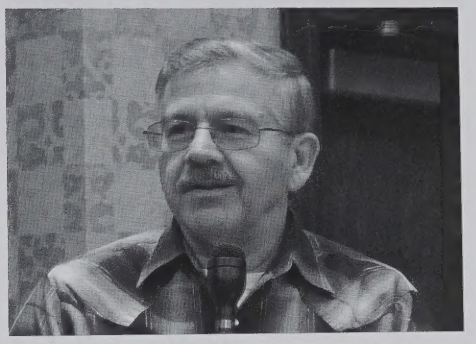
And that could put Fox-1E in competition with Fox-1Cliff for "who gets launched first." Fox-1Cliff is currently expected in the summer of 2018 from Vandenberg AFB. Perhaps the launches of E and Cliff could be the basis for a sort of "office pool" with your local ham club?

In this issue of the *Journal*, you will find an article by Marc Franco, N2UO, and Dan Habecker, W9EQ, describing the design employed in the RadFxSat-2/Fox-1E linear transponder power amplifier. Marc and Dan have played a pivotal role in the design and construction of Fox-1 radios.

ARISS Update

Frank Bauer, KA3HDO
Vice President, Human Spaceflight

[Presented at the AMSAT-NA Space Symposium, October 27, 2017, Reno, Nevada.]



I think everybody knows that we are in multiple portions of the space station. But just to reorient you, given that this is a football field size vehicle, we're predominantly being used in the Columbus module, which is on the U.S. segment and in the Russian service model. We did in the past use the Functional Cargo Block (FGB). We are doing primarily VHF in Columbus and the Russian service module, but also Slow Scan Television, which I know a lot of you have taken advantage of over the past few years. And the new addition is HamTV.

What I want to convey to you all is that right now we are doing the most in-depth and comprehensive capability we've ever done on ARISS and human spaceflight. The number of things we're doing has been very in depth. For example, from an operations perspective, right now with Paolo Nespoli on board we're doing four to five contacts per week — really a record pace right now. Some of these contacts involve multiple schools because the Italians like to embed a couple of schools in each one of the contacts.

The other thing I want to say is about space agency collaboration. We're doing a lot of work with getting not just NASA engaged, but the other space agencies much more engaged. The Deep Space Gateway represents an opportunity for a new initiative to go the next step from where we are today. From a human spaceflight perspective, we started on the shuttle. We went to Mir, and we are now in the space station. Deep Space Gateway is starting at the Lagrange point, a point of equilibrium between the Earth and Moon.

They've got requests for information or ideas right now for Deep Space Gateway. And the international AMSATs, because they have been engaged in ARISS from the beginning and have been key to our success, will be working with ARISS, which has the branding with the space agencies to submit ideas for the Deep Space Gateway for educational activities.

Now, of course, what we are going to do is make sure that we have an infrastructure of amateur radio capabilities that both the hams can employ, like Slow Scan Television on the space station, APRS and things like that, and other capabilities engaging students and schools. We're all working internationally on this idea, and we're going to be submitting some proposals to ESA in mid-November.

Let me start with sustainment, which is important because if we don't have this, we don't have ARISS. If we aren't able to keep ourselves funded and organizations engaged, we're not going to have ARISS. With what we are doing now, we're starting to look more like corporate nonprofits. We are putting together sponsorship levels according to the number of different kinds of support provided by donors.

We have a space theme associated with this. And so the top level is $75K as the "Astronaut" level. This is both real dollars and in-kind. If you don't know what in-kind is, it's predominately what AMSAT does, which is bringing a lot of volunteers to support this activity. This is where we are right now with SCAN — the Space Communications and Navigation organization — and NASA, not only because of the outreach but also because we serve the role of backup communication. So, if their communication system goes out, we're there to help.

Our supporters include CASIS (Center for the Advancement of Science in Space), which is an organization that is responsible for half the research on the ISS on the U.S. side. Then, of course, we have AMSAT. Those are at the "Astronaut Level." Then there is "Space Science," and we have JVC Kenwood that has been providing a lot of engineering work with our new radio system that is going to be flying soon as part of the interoperable radio system. And of course the American Radio Relay League, which has been involved from the very beginning of human spaceflight activities. Others are supporting us at the "Navigator Level," including DARA, as an example, and Joe Lynch [W5JPL, SK 10/19/17]. At the

"Technician Level," we have QCWA and the YASME Foundation.

We're at a point now where we are going to start advertising on our websites. You will be seeing that soon. If we are going to be seeking funding successfully, as we have been in several cases, CASIS and SCAN being the clear big ones, if you will, we have to publish an annual report. And we have put a lot of effort into putting together an annual report. This is available on dropbox if you are interested in getting a copy. If we don't have this information, we can't communicate what were doing, and we're not going to get sponsorships. We put a lot of effort into this, and in March this year, we produced our first annual report in a long time.

As a highlight of where we are, I think we are covered now in 2018 for support, and that is primarily for our mission ops support in Houston. Both CASIS and SCAN have agreed to provide funding to us. Other major sponsors, of course, are AMSAT-North America, which has been providing funding for a long time now, both financial funding and in-kind support. And ARRL, too — though a bit less now with the loss of Debra Johnson.

A big thing that's happened is we made a very gutsy move with the development of our hardware. What we did, if you haven't seen the email or the AMSAT BB, is that we decided that the only way we were going to get this hardware up to ISS in the timeframe was actually to do the safety certification ourselves. In other words, you've got ham radio operators doing the work that professional safety folks do to get us certified and flown on the space station.

Now, Lou McFadin and I have experience in this domain, so that helped. But we also recruited Ken Ernandes and Gordon Scannell. So the four of us are working on pulling together all the safety stuff. And, if you are familiar with flying on a human spaceflight vehicle, the amount of paper poundage associated with the project is about ten times greater than the devices you are trying to fly. You get an idea of how much work we're putting into this effort.

The other ongoing donation activity is our challenge coin. I still have seven coins left if people want to donate a hundred dollars or more. I'd love not to have to take them home. And I'd love to provide them to anybody that's interested. We are also considering a second edition coin because we are running out, probably a 20th-anniversary commemorative that will be bigger than the one we have right now.

If you have these big benefactors, there's a little bit of the quid pro quo. We have to do some things for them, and we've been going to a number of their events, which has been advantageous to us, too, as well as doing some ARISS contacts for them. For SCAN and CASIS, we have been doing some activities. One of them was in early February. That was at the Space Exploration Educators conference in Houston, Texas. They do this once a year. There was an ARISS contact there, as well as displays at Space Center Houston.

We also support the National Science Teachers Association conference, a huge conference. I got to go this past year. At the same time, they have the CSS, the Council of State Supervisors, which is basically for every state in the United States, they have a person who is responsible for leading what's going on in science in that state. They all came in and witnessed an ARISS contact. They got to know what we're doing and can bring it into their state.

CASIS is trying to strategically place us in certain areas to get us more visibility and also get us engaged with other organizations that potentially could provide funding for us.

Also, for SCAN, near the Glenn Research Center, they had a Girl Scout activity that was a phenomenal educational activity. With all kinds of educational activities, like teaching students about code, direction finding events and things like that, amateur radio, as well as space-oriented activities. It was a pretty phenomenal thing. We had about 300 Girl Scouts there. The day we were there, we were in a tent, and some of the girls were sitting out in the rain. They were very brave and interested in seeing this contact happen.

The ISS Research and Development conference, which we've been attending for about four years now, is a very important event for us. This is where all the major industry people are. This is where we got the funding originally from CASIS because of our networking in that environment. This past year, because it was in the Washington, D.C. area, we had a local relationship with the Tuskegee Airmen youth aviation program. Those who attended the AMSAT conference in Baltimore got to meet Col. McGee as part of that.

Youth in Aviation is primarily African-American students learning about aviation and space, and eventually, will get their pilot's license. We had five astronauts on stage with the students talking to them as part of it. It was just a phenomenal activity. We also had a booth because we are part of what is called "Space Station Explorers." Barry Baines signed an agreement with CASIS on Space Station Explorers a few months ago.

Space Station Explorers has all these educational activities that they're doing, ARISS being one of them. And they are bundling them up and bringing them to conferences so people can learn more about what's happening on the space station, and also allows CASIS to bundle us up for various donation activities. And CASIS asked us to address TDRS, the Tracking and Data Relay Satellites. They launched the most recent one, called TDRS-M, back in August. Dave Jordan went to the space center in Florida and, under the space shuttle Atlantis, was a booth for ARISS as part of that.

We have a lot of activities coming up similar to last year. Every two years in the Washington D.C. area, there is the USA Science and Engineering Festival that we will be supporting, as well the others I talked about. The other activity is at the Kennedy Space Center called the Spaceport Area Conference for Educators. Those are the ones right now that we have on the books, still tentative but on the books for next year.

With the departure of Debra Johnson from ARRL, we have been working around that. She was supporting a lot of different things, as a lot of you know, from an educational perspective — on school proposals, the website, QSL distribution, and things like that. We are working with ARRL on a transition. ARRL is not going to backfill the ARISS responsibility for education. And so we have an education committee we are putting in place instead. Rosalie White is temporarily handling the educational proposal activity.

Regarding the website, we learned a lot of things about the website after Debra left. There are capabilities we are going to be incorporating in the future, in particular integrating our social media capabilities on the website, developing a store for ARISS activities, among other things. We also are working with some of the internationals on whether we should have proposal pages for them on the website, as well as perhaps multiple languages.

We've selected our schools for the first half of 2018 at this point. Right now, we have

a call for proposals for the second half of 2018. Those proposals are due around the 15th of November. Just go to the ARISS website, and click on making a contact, and you'll see all the information about that.

We had to scramble to pull all the materials together because they were spread between ARRL's website and ARISS' website. That's all taken care of now, and we have a team in place to review proposals right after November 15.

From an operations perspective, normally we're reaching about 15,000 students per year. We are continually upping that both last year and this year with a tremendous number of schools. We don't have all the statistics here for the fiscal year. We thank the mentors for all of their efforts and making this a reality for the schools.

Regarding contacts, we have reached 54 countries at this point. We have a list available of all the states and countries ARISS has contacted.

A number you have received the slow scan telemetry, particularly our 20th-anniversary celebration, and the 12 images we sent out in July around the lunar landing anniversary. We had a lot of people tied into that, and so thank you all for actually posting your pictures on the SSTV website.

From a HamTV perspective, we are fully operational now. We are using it in a lot of different school contacts. We would be using it more if our radio system in the Columbus module were more reliable. But we are using it. One of the big innovations that has happened this year is from the UK. The BATC (British Amateur Television Club) team has developed a way to stitch together contacts throughout our chain stations of video bridges so that it all looks very seamless. You get a very long contact with these multiple stations picking up the highest signal and puts it in there, almost like the way your cell phone works. You can't tell this is happening. It's pretty cool stuff, never been done before. And it is another innovation that ham radio has done.

We are looking for United States ground stations. We've got several that are in development right now. We don't have any operational yet. So, if you are interested in that, please contact Lou McFadin or me. There are websites to help walk you through it. All this is being done with the DVB-S technology, and that's what we are going to continue to operate for the future.

From a hardware development perspective, the interoperable radio system that allows us to develop one system that can be used throughout the space station has been a vision and now is becoming a reality. The JVC Kenwood radio we feel is ready at this time. Another contribution that AMSAT is doing from a development perspective is a multi-voltage power supply. The power supply is what allows us to operate at various voltages. The space station uses 120 V DC and 28 V DC, and we need to be able to support both. Lou McFadin is leading our development effort. This will support SSTV and HamTV. It also will support our radio system.

Where we are right now is going into our major review with NASA, a major safety review. Once we have gone through phase two, we will have gone through a substantial amount of effort. And we are talking about launching middle of next year, an Orbital ATK 9 mission in May.

In the early January timeframe, we will start testing. So, we are getting closer. However, we must build ten units. So, when I start talking about costs, that is why it is so expensive. We need to build ten units to support all the things associated with what NASA and the international community need. We are talking about a quarter million dollars for this, but I mentioned we are making a gutsy move. So, that drops to $150,000 because it would cost another $100,000 if we had NASA's contractors doing the safety certification.

We are about ready to go through a fundraising activity online to try to bring in $150,000 over the next two years to help pay our bills associated with all that we need to do for this. We will offer a lot of prizes that go along with the GoFundMe effort. We try to include bonuses as milestones for people helping us out.

I want to talk next about "MarconISSta," that's Marconi ISS. "Marconista" in Italian means "radio amateur." And this an activity that its proposed for working with the University of Berlin on the idea of using our antennas as part of a spectrum analyzer experiment for a Ph.D. thesis activity with Martin Buscher.

He's going to be developing a LimeSDR and integrating it with the Raspberry Pi onboard the space station to do this experiment. Ultimately, this equipment would be left over for ARISS to use. The idea is to have the LimeSDR available to do transceiving capability.

Also, this past year our Russian colleagues threw overboard a couple of CubeSats. These two, Tanusha One and Two, fly in formation. They were developed by the Southwest State University in Kursk, Russia.

I just want to remind everybody that we need help. We need webpage developers. We need all kinds of support. If you're interested in helping ARISS, and you aren't involved now, or even if you are involved in something different, please see me. We can use your support — not only in-kind support but also financial support, too.

I just want to conclude that it's been 20 years of a phenomenal ride. What are we going to accomplish 20 years from now? We have the Deep Space Gateway as one potential, along with a lot of other things. I thank you all for your time.

eBay Sellers Donate to AMSAT

Are you an eBay seller? One item, ten items, or a full-time business you can donate a percentage of your winning bid to AMSAT.

To do so, do not list your item with the basic listing tool, select advanced tools. eBay will give you a warning message that it is for large volume sellers, however this is where the eBay for Charity tool is found.

You can "select another nonprofit you love" and search for either AMSAT or Radio Amateur Satellite Corporation. Choose the percentage amount of the sale you would like to donate to AMSAT, and boom!.

When your item sells and the winning bidder pays, eBay will deduct the percentage from your take and forward it to AMSAT.

Sometimes we are getting rid of our old equipment, sometimes selling something new. In any case, please consider giving a piece of the pie to a new satellite and choose AMSAT for your eBay Charity.

Results of The AMSAT Journal Readers' Poll 2017

Joe Kornowski, KB6IGK
Editor

AMSAT's strategic planning process kicked off last March in Orlando, Florida, to chart the future direction of AMSAT. A non-profit membership organization like AMSAT relies on its members as primary stakeholders both (a) to help provide financial support through dues and (b) to carry out the many programs and activities by volunteering often-substantial time and energy.

Accordingly, one key element in helping the AMSAT leadership determine AMSAT's future path is member engagement. For *The AMSAT Journal* that means asking readers to share their needs, desires and vision about where AMSAT should be going and how best to get there.

The *Journal* published a short informal reader's poll soliciting input in five areas:

1. New products and services
2. Eliminating one or more offerings or activities
3. Preferred methods of receiving information
4. Member recruitment
5. What AMSAT should look like in 3-5 years.

We posed five questions, one for each of these areas. The most interesting, top-rated or similar responses to the questions appear below, in no particular order. Keep in mind that (a) the response rate was very small [23] and (b) the responses are in no way scientific or statistically representative of the membership; respondents were self-selected.

Question 1.
What are 3-5 new products, services or activities that AMSAT should START offering or doing (in order of priority, 1 being highest)?

1. Build and launch HEO satellites in both high elliptical and stationary orbits
2. Online/digital AMSAT Journal
3. Actively promote "space literacy" (broader than ham radio in space)
4. Voice-recorded satellite demos on amsat.org and more how-to information
5. LEO satellites trying new technology
6. Mobile app focused on amateur radio satellite tracking and information
7. Active, well-publicized and ongoing fundraising program
8. Professional-quality videos of AMSAT at Hamvention and AMSAT Symposium/Annual Meeting for YouTube
9. More contests
10. More support for beginners & younger hams.

Question 2.
What 3-5 current offerings or activities should AMSAT STOP offering or doing (in order of priority, 1 being highest)?

1. Printed-and-mailed AMSAT Journal
2. Single-channel FM satellites

Question 3.
What are the top 3 ways that you would prefer AMSAT to communicate with you as a member (in order of priority), e.g., email, social media (Facebook Twitter, Instagram, other), website, text, HF radio nets, etc.?

1. Email
2. Website
3. AMSAT Journal
4. Regular podcasts (communications/operations, engineering/development)
5. Houston AMSAT net

Question 4.
If you were going to recruit someone in your local amateur radio club as an AMSAT member, what pitch do you think would be most successful in making that ham want to join?

1. For those in onerous deed-restricted locations, satellites offer a great alternative to HF
2. Good replacement for poor HF operating conditions (sunspot minimum)
3. Opportunities exist within this "sub-hobby" for both experimenters and communicators
4. Live demos
5. Discount coupons for equipment (manufacturers & retailers) and AMSAT store
6. Supports you as a satellite user
7. Helps support getting new satellites in orbit
8. For engineers, a chance to build satellites & learn new skills
9. More outreach to local amateur radio clubs
10. Good contesting opportunities
11. Building your own satellite ground station
12. Communicate over great distances with just a 5 W radio

Question 5.
From your perspective, what would AMSAT ideally look like in 3 years? What would it be doing? What products and services would it offer?

1. Serve as a publisher on satellite design and construction for a worldwide community
2. Membership 10x of today's
3. Vibrant website with much more new daily information
4. HEOs that work well
5. Amateur radio needs to go digital and non-real-time communications. Having the main focus of AMSAT birds being two way real-time communications is a bit of a nostalgic twist. Today's technology is expected to be delay tolerant and digital.
6. Go-to organization for higher education institutions to qualify for subsidized launches
7. Robust development program well-staffed with volunteers
8. Better tracking app
9. More "mindshare" in ham radio and maker communities
10. More training and documentation
11. Multiple HEO satellites with multiple transponders for voice and digital modes without having to invest a thousand dollars in special equipment that has no other uses
12. A 10-year satellite and technology plan
13. More extensive university/industry/government partnerships.

Some observations worth noting:

a. Several respondents expressed appreciation that AMSAT asked their opinion.
b. Two segments were not as interested in AMSAT as it is today:

(i) Those who want to return to what might be termed the "good old days" of AO-13 and AO-40;
(ii) Those representing the newer generation that prefer:
– Not working real-time communications satellites because of work and family obligations
– Digital modes
– Working on interesting technology.

2018 NASA On the Air Event

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2018 is a big year for NASA anniversaries, and the amateur radio clubs at NASA centers would like for you to help us celebrate. It will be 60 years since NASA was created, 50 years since NASA orbited the first man around the moon, and 20 years since the first elements of the International Space Station (ISS) were launched into low-Earth orbit.

The amateur radio club stations at the various NASA centers and facilities plan to be on the air with special event operations to celebrate these monumental achievements, as well as current milestones. Some clubs will be offering commemorative QSL cards, and a special certificate will be available indicating how many NASA club stations you worked on various bands and modes.

We plan to have a web-based system for you to check your points total and download a printable certificate at the end of the event in December 2018. Points will be awarded for each center worked on each band and mode (phone, CW, digital, and "space" modes). The event runs from December 11, 2017, through December 27, 2018, with the following key dates:

- Apollo 17 45th anniversary — 11-14 December 2017, beginning of event;
- NASA founded 60th anniversary (Space Act signed by President Eisenhower), 29 July 1958;
- ISS First Element Launch 20th anniversary, 20 November 1998;
- ISS Node 1 Launch 20th anniversary, 4 December 1998;
- Apollo 8 50th anniversary — launch 21 December 1968, splashdown 27 December, end of event.

Note that there will be other special event operations by the various centers commemorating and celebrating specific events, but those listed above will include participation from most of the clubs. All operating modes are fair game including "space" modes such as satellites, meteor scatter, EME, ISS APRS, etc. We hope to be on the air for casual contacts and contests as well. All contacts with NASA club stations will count toward your total. QSL cards can be requested from each club you work, and details will be on the individual QRZ.COM pages for each club callsign.

Below is a list of the participating centers a and facilities with designators and callsigns for each.

Check **nasaontheair.wordpress.com** for details of the event and information on how to check your contacts and obtain a certificate at the end of the event.

Please help us celebrate this significant anniversary year for your space agency. We look forward to working you!

The participating amateur radio clubs and the NASA On The Air (NOTA) event activities are independent of, and not officially sponsored by NASA.

Designator		Callsign	State
Ames Research Center	ARC	NA6MF	California
Armstrong Flight Research Center	AFRC	NA6SA	California
Glenn Research Center	GRC	NA8SA	Ohio
Goddard Space Flight Center	GSFC	WA3NAN	Maryland
International Space Station	ISS	NA1SS, etc.	earth orbit
Jet Propulsion Laboratory	JPL	W6VIO	California
Johnson Space Center	JSC	W5RRR	Texas
Kennedy Space Center	KSC	N1KSC	Florida
Langley Research Center	LARC	KG4NJA	Virginia
Marshall Space Flight Center	MSFC	NN4SA	Alabama
Stennis Space Center	SSC	TBD	Mississippi
Wallops Flight Facility	WFF	W4WFF	Virginia
White Sands Complex	WSC	N5BL	New Mexico

RadFxSat/Fox-1B Operational as AO-91

The Delta II rocket carrying RadFxSat (Fox-1B) launched at 09:47:36 UTC on November 18, 2017 from Vandenberg Air Force Base, California.

Following a picture-perfect launch, RadFxSat was deployed at 11:09 UTC. Then the wait began. At 12:12 UTC, the AMSAT Engineering team, watching ZR6AIC's WebSDR waterfall, saw the characteristic "Fox Tail" of the Fox-1 series FM transmitter, confirming that the satellite was alive and transmitting over South Africa. Shortly after 12:34 UTC, the first telemetry was received and uploaded to AMSAT servers by Maurizio Balducci, IV3RYQ, in Cervignano del Friuli, Italy. Initial telemetry confirmed that the satellite was healthy.

After confirmation of signal reception, OSCAR Number Administrator Bill Tynan, W3XO, sent an email to the AMSAT Board of Directors designating the satellite AMSAT-OSCAR 91 (AO-91). Bill's email stated:

"RadFxSat (Fox-1B) was launched successfully at 09:47 UTC today November 18, 2017 from Vandenberg Air Force Base in California and has been received by several amateur stations.

RadFxSat (Fox-1B), a 1U CubeSat, is a joint mission of AMSAT and the Institute for Space and Defense Electronics at Vanderbilt University. The Vanderbilt package is intended to measure the effects of radiation on electronic components, including demonstration of an on-orbit platform for space qualification of components as well as to validate and improve computer models for predicting radiation tolerance ofsemiconductors.

AMSAT constructed the remainder of the satellite including the spaceframe, on-board computer and power system. The amateur radio package is similar to that currently on orbit on AO-85 with an uplink on 435.250 MHz (67.0 Hz CTCSS) and a downlink on 145.960 MHz.

Experiment telemetry will be downlinked via the DUV subaudible telemetry stream, which can be decoded using the FoxTelem software.

RadFxSat (Fox-1B) was sent aloft as a secondary payload on the United Launch Alliance (ULA) Delta II rocket that transported the JPSS-1 satellite to orbit. RadFxSat (Fox-1B) is one of five CubeSats making up this NASA Educational Launch of Nanosatellites (ELaNa) XIV mission, riding as secondary payloads aboard the JPSS-1 mission.

Since RadFxSat (Fox-1B) has met all of the qualifications necessary to receive an OSCAR number, I, by the authority vested in me by the AMSAT President, do hereby confer on this satellite the designation AMSAT-OSCAR 91 or AO-91. I join amateur radio operators in the U.S. and around the world in wishing AO-91 a long and successful life in both its amateur and scientific missions.

I, along with the rest of the amateur community, congratulate all of the volunteers who worked so diligently to construct, test and prepare for launch the newest amateur radio satellite.

William A. (Bill) Tynan, W3XO, AMSAT-NA OSCAR Number Administrator."

Smile for AMSAT at Amazon.com

Select smile.amazon.com when making your Amazon purchases: default to Radio Amateur Satellite Corporation (AMSAT) as your chosen charity. When making purchases from Amazon, Amazon will donate .5% of a qualified purchase towards a charity. Selecting AMSAT as your preferred charity will put a smile on our satellite efforts.

Once you have selected your Amazon Smile charity, when you go to amazon.com, it will remind you to go to smile.amazon.com. Either go directly to smile.amazon or put everything you want in your cart at the original amazon.com site, then leave the site and go to smile.amazon.com, and all your items will still be in your cart.

Working the FalconSAT-3 Digipeater

Patrick Stoddard WD9EWK/ VA7EWK
wd9ewk@amsat.org

After 10 years of serving the U.S. Air Force with onboard experiments and as a training platform for the Air Force Academy in Colorado, FalconSAT-3 is now open for radio amateurs. Its 9600bps AX.25 V/U digipeater and packet mailbox quickly have become popular. The mailbox has been popular among those who used to work other packet satellites, and the digipeater is also drawing crowds. Unlike the ISS and NO-84 that operate on a single 2 m frequency (145.825 MHz), setting up for FalconSAT-3 requires a little extra work. Once you have configured your radio for FalconSAT-3, mindful of Doppler on the 70 cm downlink, you can have just as much fun working stations on this satellite. More information about FalconSAT-3 is available from AMSAT's web site[1].

FalconSAT-3 uses an uplink frequency of 145.840 MHz and a downlink of 435.103 MHz (+/- for Doppler). The uplink doesn't change, but the downlink needs to be adjusted downward throughout a pass. Here is the frequency chart:

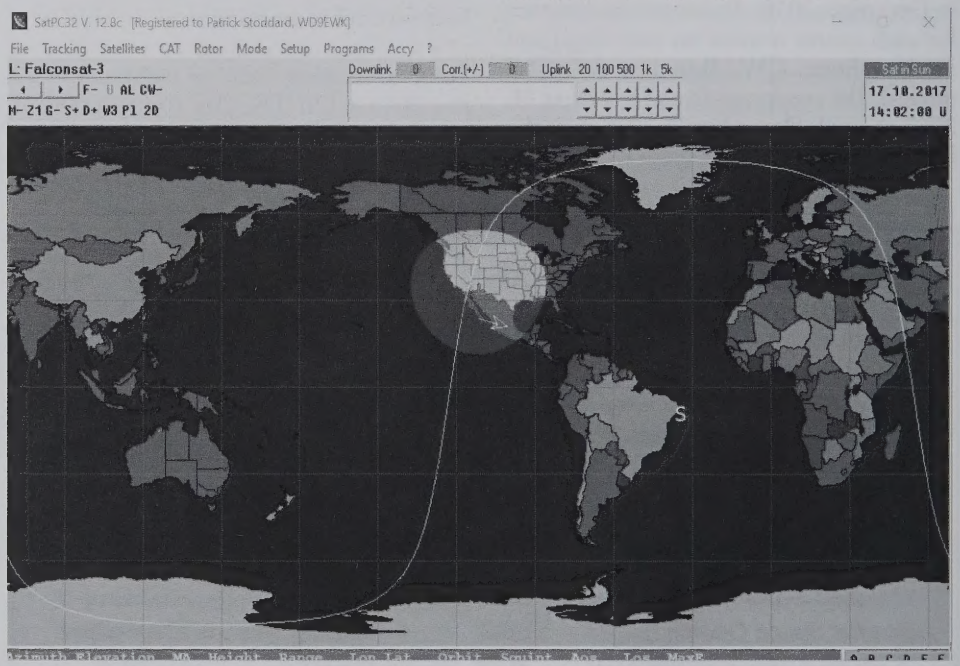
Channel	TX Freq (MHz)	RX Freq (MHz)
1	145.840	435.110
2	145.840	435.105
3	145.840	435.100
4	145.840	435.095
5	145.840	435.090

The Kenwood APRS-ready radios capable of cross-band full-duplex operation are great choices for a single radio to work this satellite. HTs like the TH-D72 and TH-D7, and mobile radios like the TM-D710 and TM-D700, work well with some changes to the configuration. Using two radios is also an option for this satellite, and one of those radios could be an SDR receiver with software like UZ7HO's HS-SoundModem software[2] to decode the 9600 bps data.

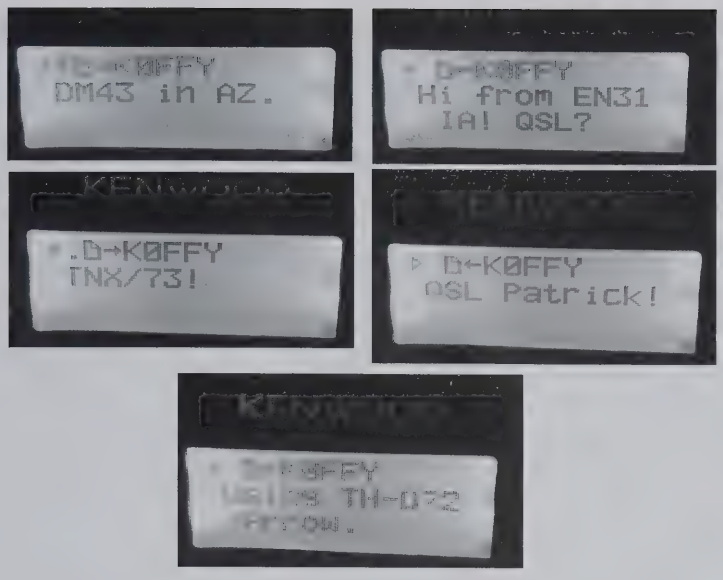
The first radio I tried with FalconSAT-3 was my TH-D72 HT. I had to adjust a few menu settings to be able to work 9600 bps packet and use both VFOs for the uplink and downlink frequencies. Menu settings I changed were:

Menu #310 (Data Band): A: RX B: TX
#311 (Data Speed): 9600 bps
#320 (DCD Sense): Ignore DCD
#3H0 (Type): Others
#3H1 (PATH): PFS3-1

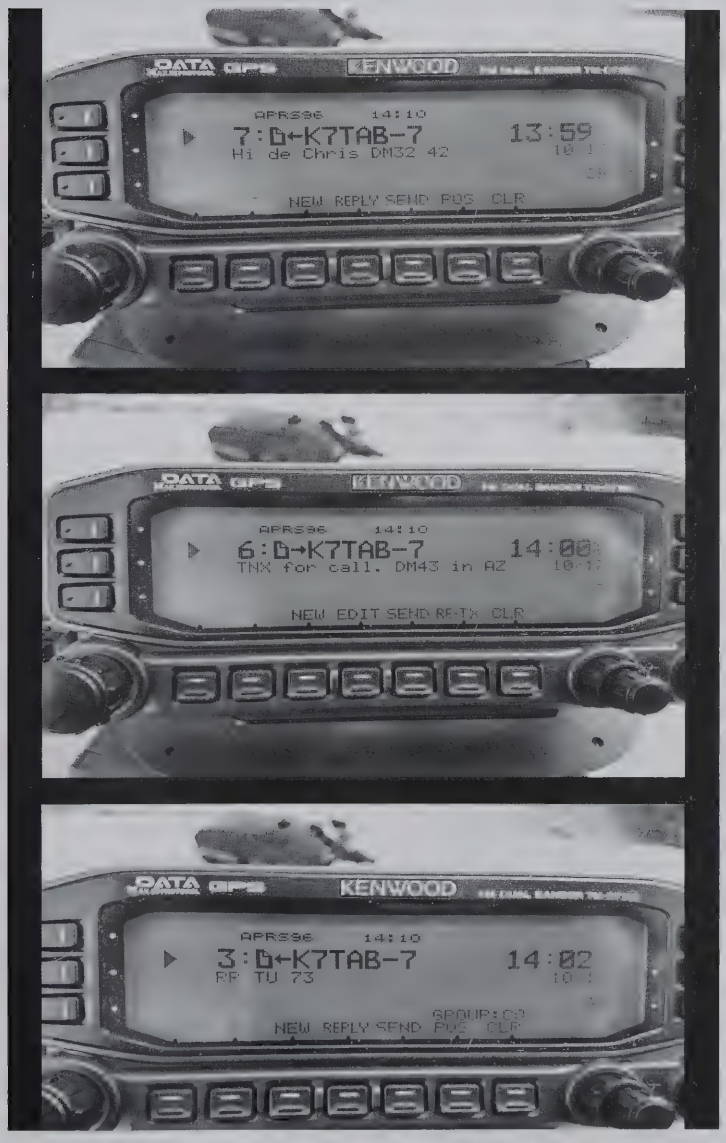
These settings enable VFO B for transmitting and VFO A for receiving. The TH-D72 only stores one "other" packet path, so those who also work the ISS or NO-84 with a


SatPC32 V. 12.8c [Registered to Patrick Stoddard, WD9EWK]
File Tracking Satellites CAT Rotor Mode Setup Programs Accy ?
L: Falconsat-3
Downlink 0 Corr.(+/-) 0 Uplink 20 100 500 1k 5k
17.10.2017
14:02:00 U

FalconSAT-3 footprint. [All photos, Patrick Stoddard, WD9EWK.]



TH-D72 QSO between WD9EWK and K0FFY.



QSO with K7TAB using TM-D710G.

TH-D72 will have to change menu 3H1 between ARISS and PFS3-1 (among other settings). Unfortunately, the TH-D72 does not provide for more than one "other" path like the newer TH-D74 does.

Before starting to work a pass, make VFO B the main VFO, and activate the "DUP" function by pressing the F key followed by the 0 key. This will allow for full-duplex operation, and help your radio receive packets as soon as transmissions end. Andrew, KE8FZT, assembled a helpful web page[3] with these instructions and screenshots. I also completely open the squelch for VFO A and set menu 120 (Audio Balance), so it is 100% on VFO A since I'm not receiving on VFO B. When you activate the TNC, "APRS96" should appear on the screen.

When working passes, VFO B should be the main VFO almost all the time, except when adjusting the downlink frequency. When it is time to tune down 5 kHz, switch to VFO A, make the adjustment, and then switch back to VFO B.

Another radio I have used to work FalconSAT-3 is a Kenwood TM-D710G. Similar to the TH-D72, a few settings must be changed to prepare for this satellite.

Menu #601 (Data Band): A: TX B: RX
#601 (Data Speed): 9600 bps
#601 (DCD Sense): Ignore DCD
#612 (Type): OTHERS
#612 (PATH): PFS3-1

The TM-D710G automatically operates in full-duplex mode whenever the two VFOs have frequencies in different bands. I use VFO A for the uplink and VFO B for the downlink. I turn the volume all the way down with maximum squelch for VFO A, and a reasonable volume level and open squelch for VFO B. When the TNC is activated, you should see "APRS96" on the screen.

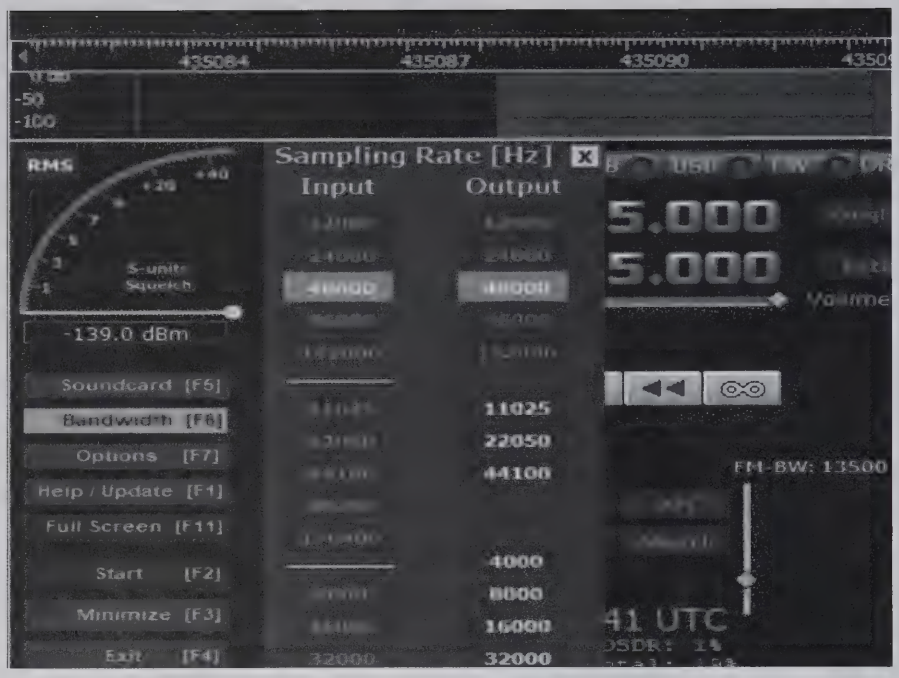
Even though the TNC has been set to always transmit from VFO A and receive from VFO B, I leave the PTT on VFO A except when adjusting the downlink frequency. When I need to make an adjustment, I switch over to VFO B, adjust the downlink, then switch back to VFO A. I make sure the line of commands showing "KEY F MSG LIST BCON POS P.MON" appears on the bottom of the display because I use some of these keys to see messages sent and received

(MSG), stations heard (LIST), and for transmitting my position/comment packet (BCON). The hand microphone isn't used unless you decide to send a message to a call sign you do not see in the MSG or LIST screens, or you want to manually enter a message for another station.

One creative combination of radios I have used to work some passes is a Kenwood TH-D74 and a SDRplay RSP1 software-defined receiver. On Twitter, I referred to this setup as my "frankenstation." I transmit with the HT, and the SDRplay is connected to a computer running a few programs — HDSDR[4], a virtual audio cable, UZ7HO's HS-SoundModem, and ON6MU's UISS[5] — on a Windows 10 tablet. I still need to configure HS-SoundModem and my tablet so it can transmit as well as receive, but the TH-D74 works for a transmitter. I have to connect both radios to my Elk antenna through a diplexer.

The TH-D74 needs a few menu settings changed for FalconSAT-3, similar to what I changed on the TH-D72 and TM-D710G:

Menu #504 (Packet Path): Use Others1, Others2, or Others3 with "PFS3-1"
#505 (Data Speed): 9600bps
#506 (Data Band): A Band (you could use the B Band, but I prefer using the A band)
#507 (DCD Sense): Off (Ignore)
When the TNC is activated, "APRS96" will be on the screen.



HDSDR settings for soundcard output.

In HDSDR, you use FM with the virtual audio cable as the output from the Soundcard (F5) menu. The output bandwidth set from the Bandwidth (F6) menu should match the audio bandwidth in your virtual audio cable, and be larger than the FM bandwidth used in HDSDR. I use 48000 as the bandwidth in my virtual audio cable and for the output bandwidth in HDSDR. While receiving, the AFC function can be activated, as HDSDR is capable of tracking the Doppler shift in the downlink signal.

The HS-SoundModem program needs the same virtual audio cable selected as its Input Device as you selected in HDSDR for the output, and for RX Sample Rate use the same bandwidth as the output bandwidth in HDSDR. DCD A should have "FSK G3RUH 9600bd" to decode FalconSAT-3. Additional configuration is needed if you use HS-SoundModem to transmit, but this is the minimum required for this satellite. Since I used 48000 as the output bandwidth in HDSDR, I use 48000 as the RX Sample Rate in HS-SoundModem.

UISS can be installed and configured to use HS-SoundModem instead of the normal SoundModem program for 1200 bps packet. UISS has different windows to display the received packets, along with any APRS messages received during passes. This two-radio setup requires me to manually enter call signs for the APRS messages I send to other stations, but the process doesn't take much time as I can use the "phrases" (preloaded messages) in the HT.

No matter which setup I use to work FalconSAT-3 (remembering to adjust my downlink frequency or using AFC), working other stations on this satellite using APRS messages is similar to working other stations on the ISS or NO-84 digipeaters. Transmit your position/comment packets periodically, send messages to other stations you see on the screen, and reply to messages received from other stations. I have worked stations

"Frankenstation" using TH-D74 with SDRplay RSP1.

with all three of these setups in the short time this satellite has been available to us.

With the TH-D72 and Elk log periodic, I made my first FalconSAT-3 QSO with Adam, K0FFY, in Iowa on September 24. We had tried to make a QSO on a mid-afternoon pass but didn't exchange messages in both directions. One pass later we did it. We also copied each others' position/comment packets.

With the TM-D710G and Elk log periodic, I worked Chris, K7TAB, on October 17 for my first satellite QSO with that radio. Chris drove south of Phoenix to park on the DM32/DM42 grid boundary, and he worked a FalconSAT-3 pass as well as an earlier SO-50 pass. I operated from my backyard. I didn't copy K7TAB's position/comment packet, but we did exchange messages. The TM-D710G is an excellent radio for working packet via orbiting digipeaters, and not just because of its three power levels (5/10/50 W).

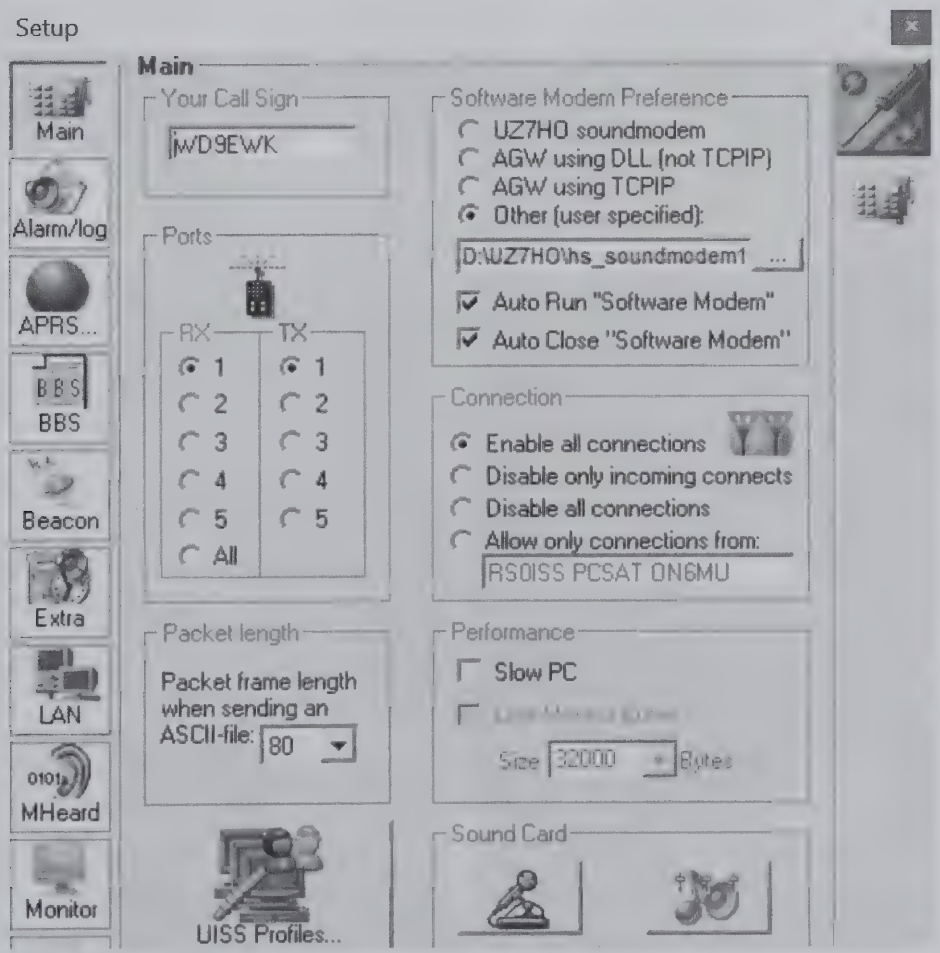
As for the "frankenstation," K7TAB was also my first FalconSAT-3 QSO with that setup on October 1. I manually had to enter K7TAB-7 when I wrote the message to Chris on my TH-D74, but I used the prepared message for my location I keep in my Kenwood APRS-ready radios. The APRS Messages window from UISS displayed the messages between WD9EWK (me) and K7TAB-7, along with K7TAB-7 attempting to work KG5GJT-7 in Louisiana. The main UISS window also showed KO4MA working the FalconSAT-3 mailbox, while the rest of us kept the digipeater active. HDSDR makes the receive side of the station work easier, using the AFC function, since FalconSAT-3's downlink is on all the time.

For anyone wanting to try using SDR to receive FalconSAT-3, I have some RF recordings — large WAV files, written by HDSDR — that can be used to test your SDR receive setup. Look in folders with "FalconSat3" in the folder names in my Dropbox space[6], and feel free to download those WAV files.

Other radios, and combinations of radios and software could be used to work FalconSAT-3. The TH-D72 and TM-D710G could be operated in PACKET96 mode connected to a computer, and other software that controls the TNCs in these radios instead of using the APRS functionality built into these radios. With WiSP or the PB/PG software, stations can work the mailbox to send and receive messages and files with other stations.

Notes

1 www.amsat.org/falconsat-3/
2 uz7.ho.ua/packetradio.htm
3 andrewbnortham.com/ke8fzt/falconsat/
4 www.hdsdr.de/
5 users.belgacom.net/hamradio/uiss.htm
6 dropbox.wd9ewk.net/



UISS software modem setup.

AMSAT-NA Board of Directors Meeting and 2017 Space Symposium

The Silver Legacy Resort, Reno. [Joe Kornowski KB6IGK, photo.]

Board members and guests. [Joe Kornowski KB6IGK, photo.]

New AMSAT President Joe Spier, K6WAO, and Immediate Past President Barry Baines, WD4ASW. [Joe Kornowski KB6IGK, photo.]

From left, Tom Clark, K3IO, Keith Baker, KB1SF/VA3KSF, Jerry Buxton, N0JY, Paul Stoetzer, N8HM, Martha Saragovitz (front), Barry Baines, WD4ASW, Joe Spier, K6WAO (front), Clayton Coleman, W5PFG, Bruce Paige, KK5DO, Bill Tynan, W3XO.

Jerry Buxton presenting CubeSat model to Barry Baines. [Keith Baker, KB1SF/VA3KSF, photo.]

Barry Baines, Garrett Skrobot (NASA), and Jerry Buxton. [Keith Baker, KB1SF/VA3KSF, photo.]

Frank Bauer presenting signed ARISS plaque to Barry Baines. [Keith Baker, KB1SF/VA3KSF, photo.]

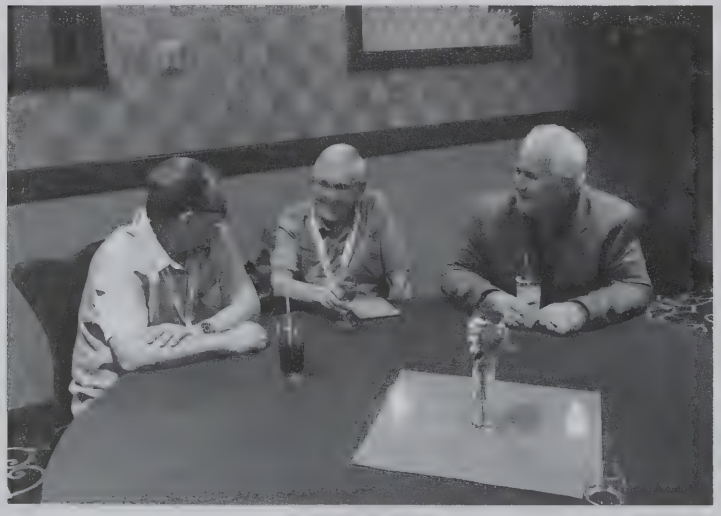
Frank Bauer presenting ARISS photo signed by astronauts to Martha Saragovitz. [Keith Baker, KB1SF/VA3KSF, photo.]

President Joe Spier and Michelle Thompson, W5NYV. [Joe Kornowski KB6IGK, photo.]

Anthony Gordon, KG6EQM, and new Executive Vice President, Paul Stoetzer, N8HM. [Joe Kornowski KB6IGK, photo.]

Center, Board member and Past President Tom Clark, K3IO. [Joe Kornowski KB6IGK, photo.]

Barry Baines and Jerry Buxton, N0JY. [Joe Kornowski KB6IGK, photo.]



Jerry Buxton, Burns Fisher, W2BF, and Garrett Skrobot. [Joe Kornowski KB6IGK, photo.]

Catching up with old friends and making new ones at Friday night reception. [Joe Kornowski KB6IGK, photo.]

Support AMSAT

AMSAT is the North American distributor of SatPC32, a tracking program for ham satellite applications. Version 12.8c is compatible with Windows 7, 8/8.1 & 10 and features enhanced support for tuning multiple radios.

Version 12.8c features:

- SatPC32, SatPC32ISS, Wisat32 and SuM now support rotor control of the M2 RC-2800 rotor system.
- The CAT control functions of SatPC32, SatPC32ISS and Wisat32 have been expanded. The programs now provide CAT control of the new Icom transceiver IC-9100.
- The accuracy of the rotor positions can now be adjusted for the particular rotor controller. SatPC32 therefore can output the rotor positions with 0, 1 or 2 decimals. Corrections of the antenna positions can automatically be saved. In previous versions that had to be done manually.
- The tool "DataBackup" has been added. The tool allows users to save the SatPC32 program data via mouse click and to restore them if necessary. •
- The rotor interfaces IF-100, FODTrack, RifPC and KCT require the kernel driver IOPort.SYS to be installed. Since it is a 32-bit driver it will not work on 64-bit Windows systems.
- SuM now outputs a DDE string with azimuth and elevation, that can be evaluated by client programs. Some demo files show how to program and configure the client.

Minimum Donation is $45 for AMSAT members, $50 for non-members, on CD-ROM.
A demo version may be downloaded from http://www.dk1tb.de/indexeng.htm

A registration password for the demo version may be obtained for a minimum donation of $40 for members and $45 for non-members. Order by calling 1-888-322-6728. The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.

12Volt Portable Dual Axis Rotor System

model: 12PRSAT

If you live in an area where you can not have a permanent outside antenna system; or you enjoy operating portable; or you want to do school and public demonstrations; or a little of each; then this Rotor System might be the solution you have been looking for.

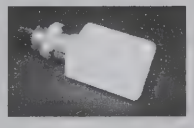
Feature Rich and designed to support popular antennas like the light weight Elk Log Periodic to the larger Alaskan Arrow up to the largest supported antenna, being the M2 LEO Pack.

(Optional Universal Mount with M2 Antennas)

(Antenna, feed-line, mast and stand not Included)

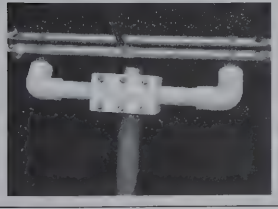
Basic Features Include:

- USB computer interface supporting popular tracking applications (GS--232A Protocol)
- Low Power 12 Volt (12-14VC) operation
- Light Weight and designed for Portable use
- Included Mag/Accel Sensor Module used for fast deployment and tracking accuracy
- Simple to use 3-Button control interface using a single 4 conductor control cable

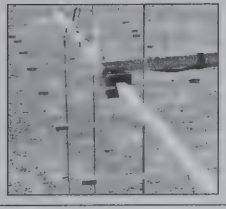


(Optional GPS Module)

(Optional Elk Mount)



(Optional Arrow Mount)



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UHF Power Amplifier with Self-Contained Dynamic Power Control for Enhanced Efficiency in Back-off Operation

Marc J. Franco, N2UO
Dan Habecker, W9EQ

(Originally published in the IEEE 2017 International Microwave Symposium Proceedings. Reprinted with IEEE permission.)

Abstract—Increasing the efficiency of power amplifiers operating at various power levels in a multicarrier, wideband application is of utmost importance when the available supply power is limited. This is the typical case of solar-powered amplifiers intended for the extension of cellular coverage into buildings and for linear transponders. In this work, we propose a novel power control technique that is a variant of the well-known average power tracking. We use a sample of the output of the power amplifier to close the feedback loop that adjusts the supply voltage, allowing for a smaller variation of gain over supply voltage and the reuse of the power detector intended for automatic gain control.

Index Terms—average power tracking, dynamic power control, power amplifiers, efficiency enhancement.

I. INTRODUCTION

Linear RF power amplifiers that are required to operate at power levels below their maximum attainable suffer from low efficiency since the output matching network cannot provide a proper match across a wide power range. The load resistance RL of a class B power amplifier is approximately given by[1]

$$RL = \frac{Vcc^2}{2Po} \quad (1)$$

where Vcc is the amplifier's supply voltage and Po is the output power.

In order to satisfy (1) for a variable output power, either Vcc or RL must be adjusted accordingly. Varying RL, also known as load modulation, can be accomplished by using the well-known Doherty technique[2]. Doherty is difficult to implement across a very wide bandwidth, which is the subject of active research[3]. Chireix and other similar techniques also suffer from similar bandwidth limitations[4]. Alternatively, envelope tracking (ET)[5] and envelope elimination and restoration (EER)[6] can provide outstanding performance by adjusting Vcc at the expense of added complexity, but the bandwidth limitations still remain.

The above-mentioned methods are very effective for signal bandwidths up to 100 MHz. However, linear power amplifiers used for the extension of mobile phone coverage into buildings (also known as bidirectional amplifiers or BDAs) and linear transponders usually amplify many signals across much wider bandwidths in the hundreds and even thousands of MHz. A simpler and very effective method to increase the power amplifier efficiency at various output power levels is to adapt Vcc to the average power of all the signals being amplified. This technique is known as average power tracking or dynamic power control[7-12]. It allows for the increase in power amplifier efficiency at back-off by operating the amplifier at a supply voltage that produces a constant level of intermodulation distortion (IMD) at every power level. Although dynamic power control may not be as efficient as envelope tracking or other similar techniques, it can still provide a significant efficiency enhancement at a smaller power overhead for very wideband applications. These power savings are of highest importance in low power, battery/solar powered equipment.

In this paper, we propose a dynamic power control technique applied to a UHF power amplifier that differs from all those described in the literature in that the power sensing is done at the output of the power amplifier instead of the input. This has two main advantages; it provides a flatter amplifier gain over power since the supply voltage can be additionally increased in order to compensate for some of the amplifier gain compression, and it also allows for the reuse of the power detector intended for automatic gain control (AGC) of the linear amplifier, which is customary in BDAs and linear transponders.

II. DYNAMIC POWER CONTROL WITH AMPLIFIER OUTPUT POWER SENSING

A simplified block diagram of the dynamic power control appears in Fig. 1. It consists of an RF envelope detector weakly coupled to the output of the RF power amplifier, followed by a sample and hold circuit. The output of the sample and hold circuit is applied to the feedback loop of a buck dc to dc converter that provides the supply voltage to the RF power amplifier. By affecting the feedback loop of the converter, the supply voltage applied to the RF power amplifier follows the output of the envelope detector.

The detector is implemented with two Schottky diodes biased by constant current sources. One diode serves as the actual RF detector, while the other diode provides a voltage reference for temperature compensation purposes[13]. The voltage output of the RF detector follows a square law function, which is necessary to provide the tracking of the Vcc^2 term in (1). A logarithmic detector [8] would not work properly in this application, neither is its wider dynamic range required. The type of peak or envelope detector proposed here provides a dynamic range of approximately 30 dB, which is more than adequate for this type of power control in which the amplifier voltage is not intended to be reduced to zero as it would in EER.

It must be noted that in situations where the peak to average ratio (PAPR) of the signal is known and constant, an average power detector may be used instead of a peak detector. The system's feedback must then be adjusted so that the supply voltage to the amplifier is such that the required IMD level is met. However, when unknown signals of various PAPRs are amplified, a peak detector becomes necessary. By detecting the peak power of the entire spectrum, the system will be able to maintain a relatively constant IMD level despite the PAPR. The resulting average power will then vary according to the PAPR, while the peak power will remain the same.

The output of the peak detector is applied to a peak hold circuit, which provides a fast attack and a low decay function. Since the bandwidth of the dc to dc converter is

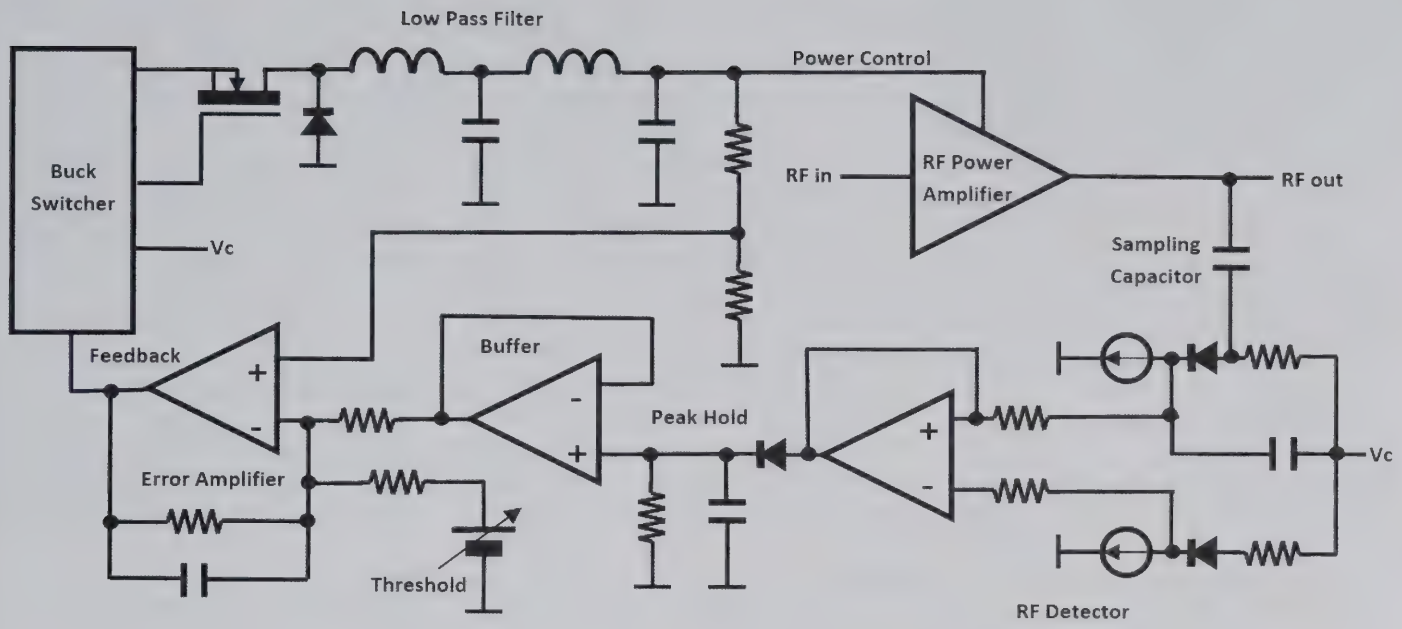

Fig. 1 — Simplified diagram of the dynamic power control system.

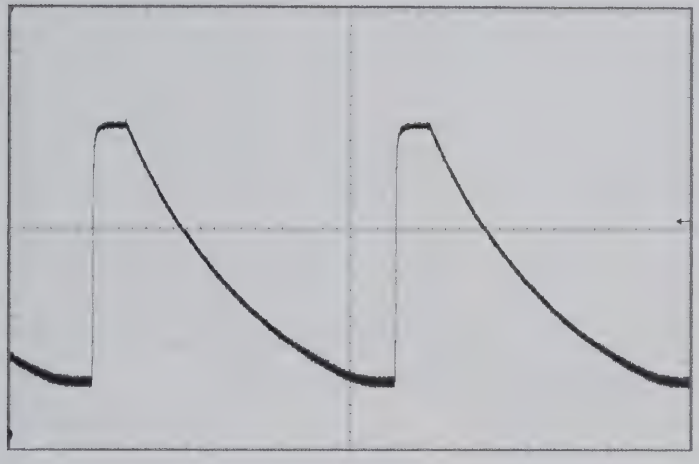

Fig. 2 — Power amplifier dynamic supply voltage in the time domain with a one-second-long pulsed input signal. Scales: 2 sec/DIV, 0.4 V/DIV.

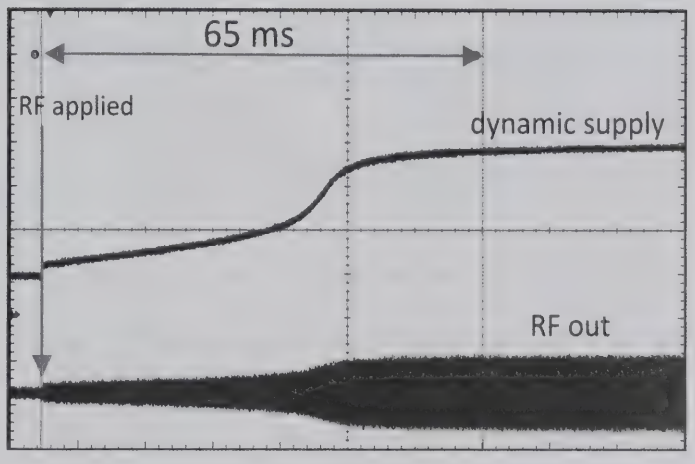

Fig. 3 — Power amplifier dynamic supply voltage attack time (top trace) after the application of an RF pulse (bottom trace, output of the amplifier). Time scale: 10 ms/DIV.

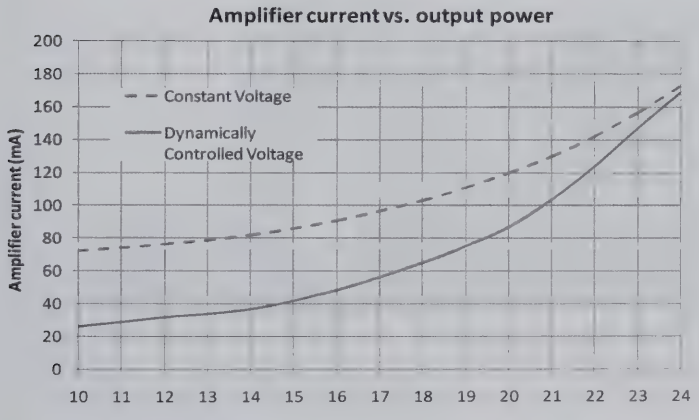

Fig. 4 — Current draw of the power amplifier under dynamic power control and constant supply voltage. The current of the power control is included.

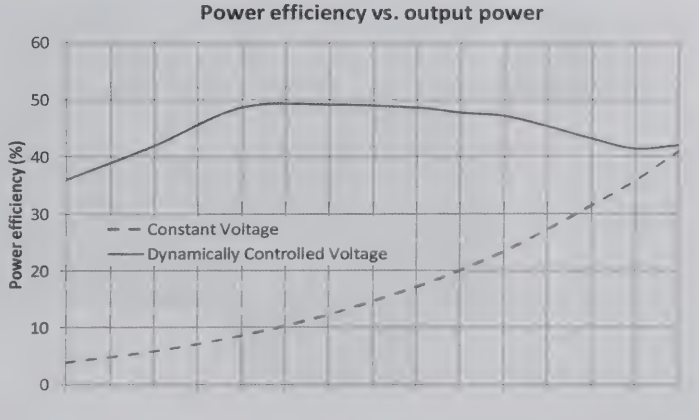

Fig. 5 — Power efficiency of the power amplifier under dynamic power control and constant supply voltage.

narrow and it is not possible to follow the envelope of most signals, the attack time is reduced to the minimum possible, whereas the decay time is extended to approximately five seconds, which proved to be adequate for this specific application (Fig. 2).

The attack time is shown in detail in Fig. 3. The bottom trace is the RF output after a pulse is applied to the input of the amplifier and the top trace is the dc voltage applied to the amplifier. It can be observed that it takes approximately 65 ms to settle. There are no signs of overshoot.

The error amplifier provides unity, noninverting gain to the dc to dc converter feedback loop and inverting gain greater than unity to the RF detector signal. By adjusting this latter gain, it is possible to set the operating point of the adaptive power control for a given IMD performance. Too much gain would introduce instability in the form of the dc to dc converter operating at its maximum voltage regardless of the input signal level. By reducing the gain of the error amplifier, stability can be achieved, and the IMD level can be set to any value, with the added capability of trading off power efficiency for IMD level.

The threshold voltage applied to the error amplifier sets the minimum operating voltage of the power amplifier for very small input signals.

III. EXPERIMENTAL RESULTS

The dynamic power control system was breadboarded using a Qorvo RFPA0133 GaAs amplifier operating at 435 MHz. Fig. 4 shows the current draw with a fixed 3.6 V supply and the dynamic power control, obtaining very significant current savings. The power sweeps were obtained using a single tone signal. The current consumption of the dynamic power control circuitry is included. Fig. 5 shows the power efficiency under the same conditions.

The dynamic power control was adjusted for a 20 dBc IMD level, which is maintained across a wide range of output power. Fig. 6

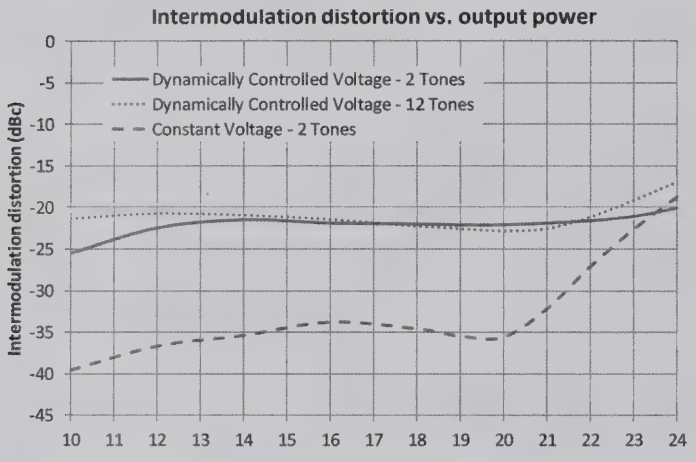

Fig. 6 — Intermodulation distortion under dynamic power control and constant supply voltage. Note the similarity in performance for 2 (12 kHz spacing) and 12 tones (1 kHz spacing) using dynamic power control. directional coupler. The power control circuitry is located at the bottom of the board.

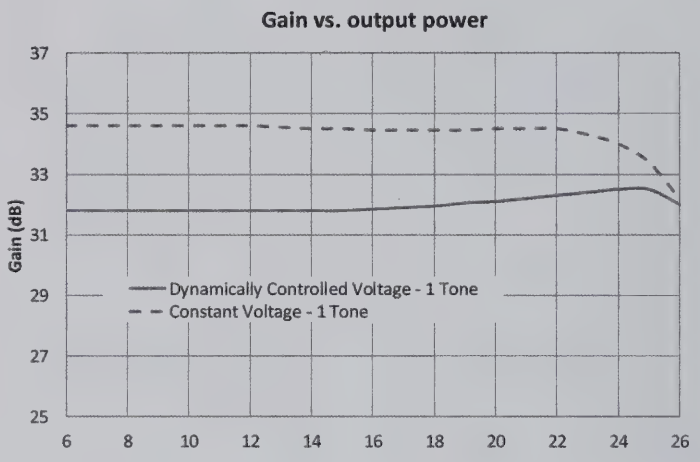

Fig. 7 — Gain as a function of output power under dynamic power control and constant supply voltage.

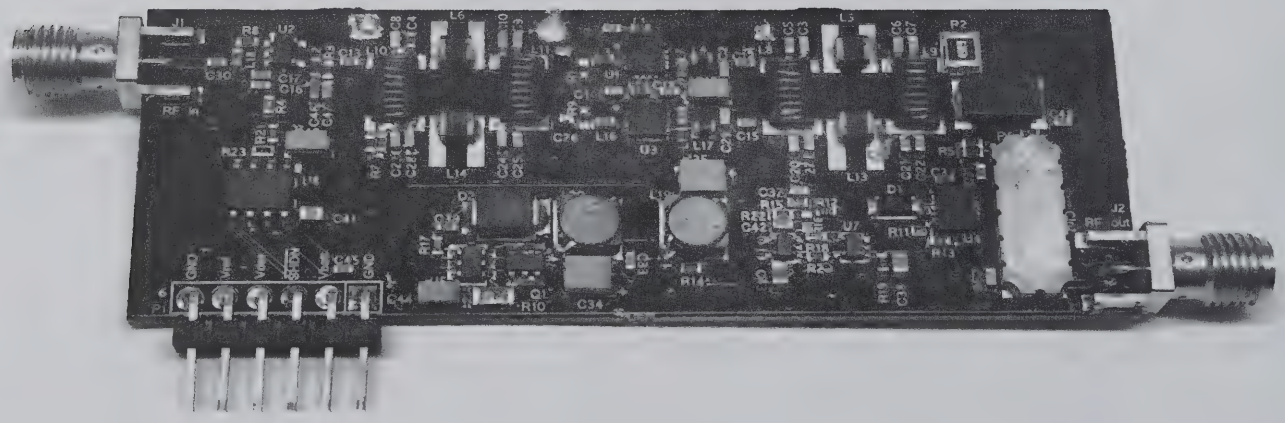

Fig. 8 — Photograph of the prototype using two RF power amplifiers in quadrature, a driver stage, a low pass filter and a directional coupler. The power control circuitry is located at the bottom of the board.

shows measurements using 2 and 12 tones. As stated earlier, the IMD can be maintained approximately constant independently of the signal's PAPR without any adjustments.

Fig. 7 shows the single-tone gain of the amplifier operating at a fixed voltage or under dynamic power control. The slight gain expansion produced by the higher supply voltage can be used to compensate for some of the amplifier gain compression.

Fig. 8 shows a photograph of the prototype system using two RFPA0133 amplifiers in quadrature under dynamic power control. The design includes a driver stage, a low pass filter and a surface-mounted directional coupler. The performance of this implementation is identical to the original breadboard presented here in terms of linearity and efficiency, but approximately twice the output power can be obtained.

IV. CONCLUSION

Sampling the signal at the output of the power amplifier provides excellent results for dynamic power control, allowing for the reuse of the power detector intended for AGC purposes and maintaining the IMD level constant regardless of the signal PAPR. The method has no bandwidth restrictions other than those imposed by the power amplifier itself and can provide a significant improvement in power efficiency at back-off operation.

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A Visit to Tokyo, Japan, and the Tokyo Ham Fair 2017

Keith Baker, KB1SF/VA3KSF

[Portions of this article appeared previously as "A Visual Tour of the 2017 Tokyo Ham Fair" in the October 2017 edition of The Spectrum Monitor Magazine.]

In early September 2017, I had the distinct honor of being an "ambassador" for the Dayton Amateur Radio Association (DARA) at the big Tokyo Ham Radio Fair in Tokyo, Japan. Our mission was to personally invite Japanese hams to join us in Dayton, Ohio, for next year's big Dayton Hamvention.

However, unlike the Dayton Hamvention, which is sponsored by one of the largest (if not THE largest) amateur radio clubs in the United States (DARA), the Japan Amateur Radio League (JRRL) — the Japanese equivalent of our American Radio Relay League (ARRL) — conducts the Tokyo Ham Fair each year.

And the two venues couldn't be more different. While Hamvention recently moved from its long-time home at Dayton's Hara Arena (which is now closed) to new "digs" at the Greene County Fairgrounds in Xenia, Ohio, the Ham Fair is held in a HUGE convention complex called the "Tokyo Big Sight." In fact, the complex is so massive that the Ham Fair occupied only one of many large convention areas at the venue. And all of it was conducted under a single, massive roof.

Our Hamvention booth at the 2017 Ham Fair was very busy. We spoke with hundreds of Japanese hams, posed with scores of them for countless pictures, and gave away all of the 1600 Hamvention "trinkets" that we brought along during the two-day event.

Also, as I'm the current Treasurer and a Past President of AMSAT-NA, I took time out during the show to visit with our JAMSAT compatriots in their booth just around the corner from ours. They, in turn, visited with us in our booth. Our visits were both pleasant and informative.

I've since learned that this year's Ham Fair attendance was somewhat increased from previous years, with over 39,000 hams from all over the world attending. Clearly, like the Dayton Hamvention, it's a world-class event for radio amateurs as well as short-wave listeners and scanner enthusiasts.

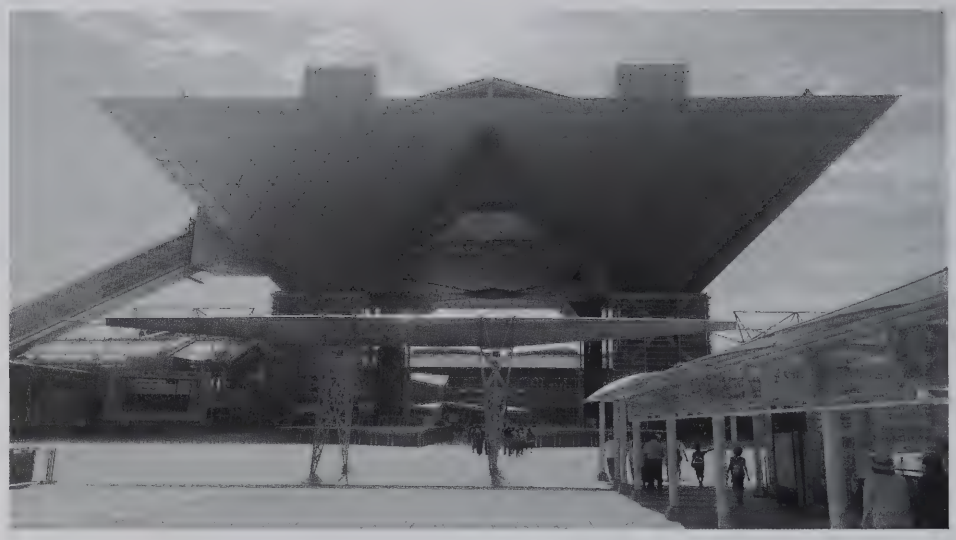
The Akihabara

Just prior and just after the event, members of our Dayton Hamvention team and I also visited the Akihabara section of downtown Tokyo. Called "Electric Town," it's the district in Tokyo where one can find all manner of electronic equipment being offered. On my two previous trips to Japan, there were upwards of nine amateur radio shops located within a three-block area in the Akihabara. However, this time, that number had dropped to only three or four, with all manner of other electronic offerings (including cell phone accessories and computers) in countless other shops in the district.

One of the largest ham radio stores in the Akihabara (called "Rocket") even has its own song that is posted as an MP3 on their website and continuously played on speakers in the store as you visit. The song can be found at rocket-co.jp. Scroll down to the photo of the old phonograph and click on "Welcome to Rocket," and then the MP3 icon. While most of the words are in Japanese, the title "Welcome To Rocket" appears a couple of times while the song plays.

Among the features of the Akihabara district are the numerous small electronic parts kiosks located within several of the buildings. These little vendor areas are often so small that one can barely see the proprietor tucked away behind their vast array of specialized electronic parts. In fact, these merchants are often so specialized that one will sell only electronic switches. Another offers only resistors, while another vendor's specialty is every kind of electronic plug that you can imagine. And it's all located within one or two (often multi-floored) buildings in the Akihabara.

Clearly, the Akihabara is a radio hamfest on steroids…and it happens every single day of the week! Any visit to Tokyo for a ham radio or short-wave enthusiast should include at least one morning or afternoon on the itinerary of browsing around the Akihabara!



The 2017 Tokyo Ham Fair, sponsored by the Japanese Amateur Radio League (JARL) was held over our USA Labor Day weekend at the Tokyo Big Sight, a huge convention complex in the Waterfront District of Tokyo, Japan. [All photos, Keith Baker, KB1SF/VA3KSF, unless otherwise noted.]

A young Japanese satellite operator shows off his satellite antenna made out of pieces of wire and strips of cardboard taped together for the boom.

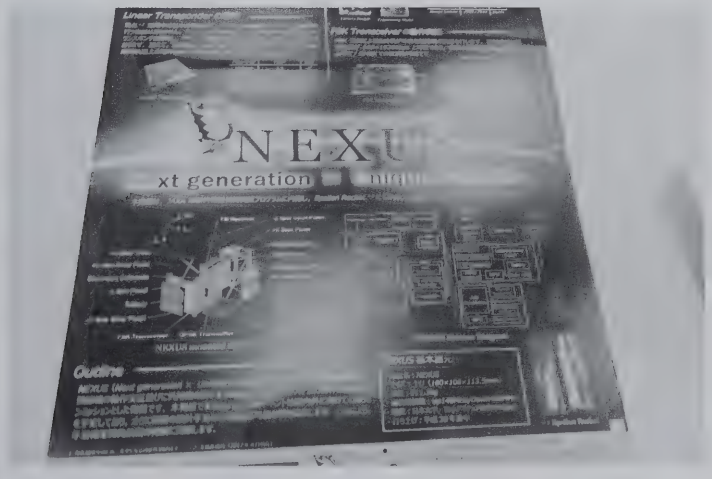
The 2017 Tokyo Ham Fair was just one of several ongoing conventions being conducted at the Tokyo Big Sight.

One ongoing JAMSAT project is their NEXUS (NEXt Generation Unique Satellite). Members of the Tokyo Ham Fair JAMSAT team had prototype circuit boards for the satellite on display in the JAMSAT booth at the show.

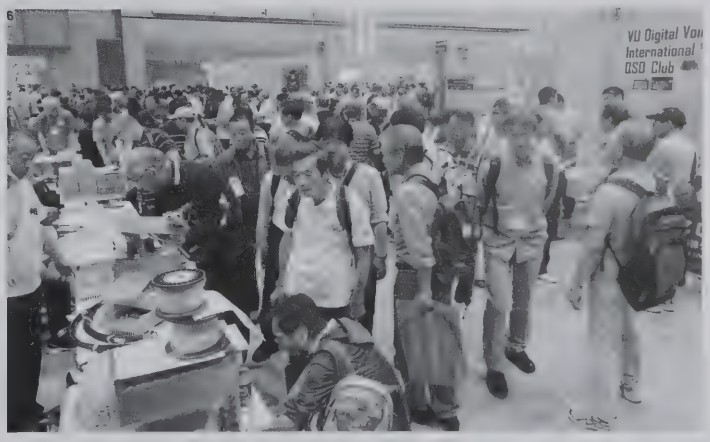
Several JARL and International Amateur Radio Union (IARU) officials did the ribbon cutting to formally open the show. The ceremony was complete with a Japanese military band providing fanfare music. [Courtesy: DARA.]

Members of the JAMSAT NEXUS Satellite team also had a poster on display at the JAMSAT booth showing the planned capabilities of the new satellite.

Dayton Hamvention members at the show booth included (from left) Michael Kalter, W8CI, DARA Treasurer, Tim Duffy, K3LR, the author and Jay Slough, K4ZLE. We came "armed" with well over 1600 Hamvention-themed giveaway items, all of which were given away during the show.



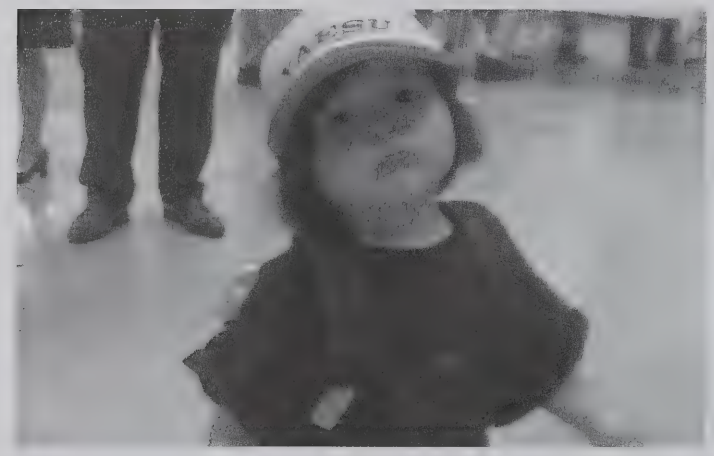
JAMSAT's new NEXUS satellite is slated to feature both digital and analog transponders. No word yet on a possible launch date.



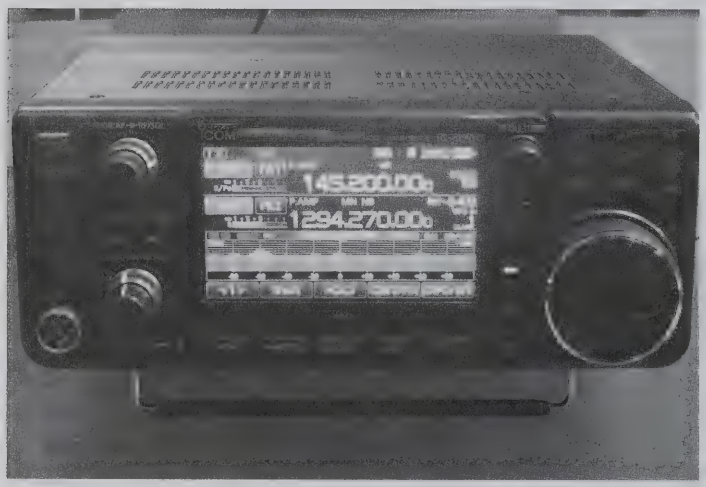
As with any amateur radio convention, there is usually more to look at than one could see in a single day.

Being the AMSAT-North America Treasurer, I took a brief time out from my Hamvention duties to stop by and visit with our Japanese compatriots at their JAMSAT booth.

Clearly, the Japanese are very interested in getting their youngsters interested in radio construction at an early age. Here, a budding Japanese radio enthusiast assembles one of the many radio kits that were made available to youngsters in a construction area set aside exclusively for that purpose at the show.



A young budding Japanese ham operator moons for the camera at the 2017 Tokyo Ham Fair.



One of the new radios featured at the show was the ICOM IC-9700, a VHF/UHF, all-mode, and satellite-capable radio. It features variable power output of 50 W for VHF and UHF and 10 W output on 1.2 GHz. Despite my questions, no word was given on price or North American availability.

Many of the large Japanese manufacturer booths were giving away various promotional items to passersby.

The author meets with one of the many costumed characters that were wandering about at the show. [Courtesy: DARA.]

One of the many young Japanese radio hams that stopped by our booth to chat about coming to the Dayton Hamvention sometime in the future.

Many amateur radio dealers wrap their display items in plastic to keep the items clean of oily fingerprints for a later, actual sale. sometime in the future.

The Alinco Radio booth at the Ham Fair. The major manufacturer booths were all located in the same general location, labeled the "JAIA area." The JAIA, also known as the Japan Amateur Industry Association, is a consortium of major amateur radio manufacturers in Japan.

Yaesu was well represented by its large booth at the show.

Hams are hams the world over…always on the lookout for a bargain!

Recognition and Thanks to Our Dedicated Volunteers in 2017

Organizational

Barry Baines, WD4ASW

In Recognition of Your Outstanding Contributions to AMSAT

Thank you for decades of service to the AMSAT mission and for your tireless and inspiring leadership and guidance. Your support of *The AMSAT Journal* is reflected by your vision, informative updates, high-level perspectives and insights through your "Apogee View" column in every issue have made *The AMSAT Journal* the flagship voice of AMSAT and a must-read for every member. In addition to your many other duties, obligations and contributions to AMSAT as President, you have never missed a *Journal* deadline — truly outstanding!

Thank you for decades of service to the AMSAT Field Operations Team. In addition to your many duties to the AMSAT organization you make time to support the Field Ops team at conventions, hamfests, clubs and talks. We are honored to have your continued support and leadership.

No one certificate can adequately describe the enormous contribution you have made to AMSAT over the years.

Martha Saragovitz, Manager

In Recognition of Your Outstanding Contributions to AMSAT

Thank you for your four decades of service to the AMSAT mission and for your tireless and inspiring daily work for the organization. Your support of the AMSAT office, the Board of Directors, officers, many Presidents, and all the members over the years has been exceptional.

No one certificate can adequately describe the enormous contribution you have made and continue to make to AMSAT daily.

Presidential

Frank Bauer, KA3HDO

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your continued strong leadership of ARISS and ARISS-I. You continue to guide ARISS through a sea of changes in relationships, funding and roles and responsibilities of our ARISS volunteers. You've enhanced the level of collaboration through an MOU signed by AMSAT and CASIS. ARISS-I continues to evolve as well. Under your leadership, significant progress has been made in creating the next generation of amateur radio capabilities to enhance amateur radio's future on the ISS. Your dedication and passion for ARISS continues to inspire those with whom you work.

Steve Belter, N9IP

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your stewardship of AMSAT's presence at the Hamvention for the past five years with 2017 being the last year for you in this role. Your leadership of AMSAT at amateur radio's largest convention is reflected by the successful transition to a new venue, helping all of our volunteers adapt to a new booth location. Just as important, you developed a new booth layout configuration and convinced the AMSAT Senior Leadership Team to invest in a larger booth presence that provides the space to highlight AMSAT and ARISS as well as worked out the arrangements for an excellent outdoor location to provide satellite demonstrations. Your direct involvement in the expansion of content found in Getting Started with Amateur Satellites resulted in setting new levels of quality and value of the book as a resource to the amateur satellite operator community.

Joseph Kornowski, KB6IGK

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your continued leadership of *The AMSAT Journal.* Each issue has exceeded our expectations regarding content as well as being delivered to our membership on time. You've developed an effective team that manages the process that creates the product which is considered to be the key benefit of AMSAT membership. I also thank you for your participation in AMSAT's Strategic Planning process as well as highlighting our strategic planning efforts in *The AMSAT Journal.*

Jerry Buxton, N0JY

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your outstanding engineering leadership that has resulted in the successful development of four spacecraft in the Fox-1 series with a fifth satellite to be completed shortly. Along with managing a successful engineering team for the Fox-1 program, you've established relationships with universities that have resulted in new opportunities for flying the Fox-1 design, including having the Fox-1E communications package be adapted by University of Washington for use on their CubeSat. Meanwhile, you have shepherded current efforts to develop 5 GHz/10 GHz ground terminal design adaptable for a variety of spacecraft including the CubeSat Challenge, collaborate with Ragnorak to provide a communications payload, eventual development of a HEO 6U CubeSat as well as a P-4B payload. Your leadership by example continues to inspire the Engineering Team. Your countless man-hours focused on completing the Fox-1 series projects is deeply appreciated.

Andrew Glasbrenner, KO4MA

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for managing our relationship with Spaceflight, Inc. in support of Fox-1Cliff and Fox-1D resulting in a revised launch program that will soon have these two satellites in orbit. Thank you for establishing the framework resulting in the transition of FalconSat-3 to a full-time amateur spacecraft. You continue to manage AMSAT's social media presence. Your direct involvement in AMSAT's Strategic Planning process, assisting with pre-meeting activities to help formulate how the "kickoff" weekend would be conducted is appreciated.

Bruce Paige, KK5DO

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your continuing management of AMSATs Awards Program. The issuance of certificates coupled with review of submissions to ensure that each submission fully qualifies takes time and attention to detail. In addition, your support of the new AMSAT Store has improved how the AMSAT Store reflects our product offerings. Your willingness to take on such behind-the-scenes tasks is greatly appreciated.

With extreme dedication to promote amateur radio satellites you have hosted the Houston AMSAT Net in cooperation with Marty Smith, WV5Y, and Andy Mac Allister,

W5ACM , to provide weekly content around the world. Your net is available on RF, via the Internet, and via telephone and offers one of the most accessible and informative outlets to learn about the amateur satellite community.

Paul Stoetzer, N8HM

In Recognition of Your Outstanding Contributions to AMSAT Operations

Thank you for the variety of ways that you continue to enhance AMSAT. In addition to fulfilling your duties and responsibilities as Corporate Secretary, including the handling of the 2017 BoD election and the drafting of minutes for AMSAT Board Meetings, you also provided valuable support in a variety of ways. You helped to formulate plans for the AMSAT Strategic Planning Kickoff meeting that took place in Orlando the weekend of 3 MAR 17. You've helped Martha with IT questions as well as serving as a signatory to the AMSAT checking account. You've been instrumental in the implementation of changes to the new AMSAT website and AMSAT Store as well as created content. The satellite demos that you conducted at Hamvention @ Xenia, OH and the New England ARRL Convention @ Boxborough, MA were well attended and created significant 'buzz'.

Thank you for collating and publishing throughout the year important news about grid and DXCC expeditions that include satellite operations as well as your regular contributions to the AMSAT Journal.

Your willingness to lend a hand when needed is deeply appreciated.

Keith Baker, KB1SF

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your support of AMSAT's financial and strategic planning activities. Along with fulfilling your duties as Treasurer, you made a significant impact during the AMSAT Strategic Planning Meeting in Orlando, agreeing to take on the 'Financial Results" area of focus. You've subsequently followed through in this area, crafting articles for *The AMSAT Journal* to talk up the process and encourage membership participation. I also appreciate the feedback and counsel you've provided to me during my tenure as President based upon your past experiences holding this office.

Clayton Coleman, W5PFG

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for your support of AMSAT's Strategic Planning process. You provided input used to create the process that was followed during our kickoff meeting in Orlando the weekend of 3 MAR 17. You have been very helpful in following up on the process through interaction with the IT team in the development of new IT capabilities that were installed over the summer. Your willingness to provide input to the Board on membership outreach and to create new mechanisms for communication with our members has been very helpful.

Dave Jordan, AA4KN

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for serving as 'chief scribe' at the AMSAT Strategic Planning Conference in Orlando, FL that took place the weekend of 3 MAR 17. The strategic planning process created a significant amount of material that needed to be captured as a result of the work done that weekend. You worked closely with our consultant (Tony Silbert) to make certain that you understood the planning process being followed and what his expectations were on data collection. Once the weekend concluded, you spent considerable time pouring through the materials that were collected and the notes you took to provide a document that captured what transpired that weekend. Your summation of the information collected, the plans/timelines created, and next steps defined has been critically important as a key tool to ensure that we don't overlook what was accomplished at Orlando which serves as the 'kickoff' for AMSAT strategic planning going forward.

Joe Fitzgerald, KM1P

In Presidential Recognition of Your Contributions to the AMSAT Mission

Thank you for leading AMSAT's information technology transition. You provided recommendations to the AMSAT Board of Directors on how to proceed in the development of a new AMSAT website, the creation of a more effective Store, and development of a new membership database, suggesting that contracting with a firm was a more effective approach than depending upon volunteers. The Board accepted your recommendation. You proceeded to select a contractor, reviewed their development efforts and AMSAT now has a new website and AMSAT Store. Development work continues on the memberships database which has the potential to significantly enhance our ability to provide membership services as well as provide a 'cloud-based' approach to data management.

Educational Relations

Drew Deskur, KA1M

In Recognition of Your Outstanding Contributions to AMSAT Educational Relations

Thank you for agreeing to direct the development of a Curriculum Guide.

Richard Siff, WA4BUE

In Recognition of Your Outstanding Contributions to AMSAT Educational Relations

Thank you for the Preliminary Design and your support for the development of the multiple CubeSat Simulator Program.

Pat Kilroy, N8PK

In Recognition of Your Outstanding Contributions to AMSAT Educational Relations

Thank you for the Preliminary Design and for agreeing to lead the development of the multiple CubeSat Simulator Program.

Engineering

Ray Roberge, WA1CYB

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your excellent contributions on the P5/CQC project in developing and prototyping our satellite on the way and into lunar orbit. In addition, your work as the primary SDR architect for the project and your demonstrations of several innovative transponder designs that enhance the versatility of conventional analog transponders give AMSAT many opportunities in our future missions. You have been a tireless and positive volunteer throughout the often-trying situations in the P5/CQC project.

Robert Davis, KF4KSS

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your selfless choice to put AMSAT ahead of personal time in preparing Fox-1D for launch and for your countless hours toward the successes of the ARISS MVPS project and the Fox-1 project. You provide information and insight on current, past, and future projects that is invaluable in the success of our efforts. The success of the Fox-1 and ARISS MVPS projects are a direct result your devotion to AMSAT.

Howie DeFelice, AB2S

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for the hard work you have put forth toward our first P5 satellite through the Heimdallr CQC project. The technology development for our part of the project will have an impact and use in our future missions, and the relationship you built with Luigi and Ragnarok is an asset to AMSAT. Despite Heimdallr not being chosen as one of the three that will be manifested on the mission, you continue to work on opportunities that are a result of the technology and partnership you and your team developed that will advance our desires to reach HEO and to make "Five and Dime" part of our future satellite missions.

Burns Fisher, W2BFJ

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your consistent presence and support in the re-work and environmental testing of Fox-1D, for all things from transportation to shipping to hospitality. Your devotion to the development of the Fox-1E IHU code and telemetry downlink, and lastly, for your work in successfully migrating Fox-1 software/hardware testing to the New England Fox associated labs is appreciated. Your work is reflected in the success and improvements in each of the Fox-1 CubeSats.

Dan Habecker, W9EQ

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for being the first responder to the "Greensboro, we have a problem" calls for help in diagnosing and repairing RF related issues that seemingly occur when there is virtually no time left in completing a Fox-1 CubeSat. And thank you for your hard work in making the Fox-1E Linear Transponder a reality. The LT will provide opportunities for AMSAT to put more amateur radios in space through our partnerships and in our own future satellites.

John Klingelhoeffer, WB4LNM

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your continued support and guidance in the development of the Fox-1E Improved Command Receiver and Fox-1E Linear Transponder, as well as visions for radio opportunities on many bands for future satellites. Your devotion to AMSAT, which continue even in your "Retirement" are invaluable.

Lou McFadin, W5DID

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your superb reliability and quick turnaround in the production of the Fox-1 series CubeSats, and for your work in finding a reliable solution to the attachment of the antennas as well as applying them to the new builds. Your devotion to AMSAT shows as well, in your help for all things when called upon including applying "real antennas" to the Fox-1 Life Size Model that is popular at so many hamfests and other venues.

Michelle Thompson, W5NYV

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for your continuous inspiration of the AMSAT Ground Terminal team in advancing the project and your work in expanding the technology and interest to groups outside AMSAT. The momentum you shepherd brings excitement and support of AMSAT's purpose, and taps new groups of young volunteers that will be part of the AMSAT future.

Eric Skoog, K1TVV

In Recognition of Your Outstanding Contributions to AMSAT Engineering

Thank you for taking on the construction and testing of the Improved Command Receiver, while at the same time keeping the Fox-1E project management focused and moving forward. Your work in developing and pushing forward the Fox-1E LT "black box" project with our partner the University of Washington and your work in migrating Fox Labs to the New England Fox Den are appreciated. You stepped up to be a much-needed major player in AMSAT Engineering and continued your work even after finding, as we all have, that it is no small task. You chose to continue where many have shied away due to the amount of work, and made things happen.

Operations

Jim White, WD0E

In Recognition of Your Outstanding Contributions to AMSAT Operations

Thank you for your leadership and persistence in making FalconSAT-3 available for amateur satellite users.

Mark Hammond, N8MH

In Recognition of Your Outstanding Contributions to AMSAT Operations

Thank you for your dedicated service as a command station for multiple satellites, and timely efforts to transition FalconSAT-3 to the Amateur Satellite Service.

Mike Rupprecht, DK3WN

In Recognition of Your Outstanding Contributions to AMSAT Operations

Thank you for your wide support for all things amateur satellite, including your webpage, status updates, and telemetry software.

User Services

Alan Biddle, WA4SCA

In Recognition of Your Outstanding Contributions to AMSAT Operations

Thank you for your work to revise and update Gould Smith's Getting Started With Amateur Satellites. This book is AMSAT's best guide to operating the amateur satellites for newcomers to our hobby.

You kept up and supported the AO-85 telemetry system, and your willingness to take on multiple short-term projects and investigations.

Andy Mac Allister, W5ACM

In Recognition of Your Outstanding Contributions to AMSAT User Services
With extreme dedication to promote amateur radio satellites you have hosted the

Houston AMSAT Net in cooperation with Bruce Paige, KK5DO, and Marty Smith, WV5Y to provide weekly content around the world. Your net is available on RF, via the Internet, and via telephone and offers one of the most accessible and informative outlets to learn about the amateur satellite community.

Charles Bradley, KG5JUP

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your hard work and dedication as a Weekly Editor of the AMSAT News Service in the publication of the weekly ANS Bulletins. The ANS Bulletin has significant worldwide reach and is highly regarded for the quality of publication.

Chuck Pinkham, K3PER

In Recognition of Your Outstanding Contributions to AMSAT User Service

Thank you for being an essential part of AMSAT's presence at the new venue for the Dayton Hamvention. Your continuous presence before, during, and after the Hamvention facilitated the presentation of the AMSAT story to the wider amateur radio community.

Douglas Quagliana, KA2UPW

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your continuing support and expertise as an Assistant Editor of *The AMSAT Journal*. Your editorship, attention to detail, satellite knowledge, and close support of the content and appearance of the articles improve the quality of the *Journal*.

Gould Smith, WA4SXM

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your active participation in AMSAT's presence at the Dayton Hamvention and for your authorship and contribution of the book Getting Started With Amateur Satellites.

Patrick Stoddard, WD9EWK

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for continuing to support the AMSAT mission over the last year. You are a model to the AMSAT Field Operations team by conducting many satellite demonstrations, club talks, hamfests and conventions, as well as user support.

Phil Smith, W1EME

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for being an essential part of AMSAT's presence at the new venue for the Dayton Hamvention. Your contribution before, during, and after the Hamvention along with your enthusiasm for our hobby has contributed directly to AMSAT's successful participation in the Dayton Hamvention.

Bernhard Jatzeck, VA6BMJ

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your continuing support and expertise as an Assistant Editor of *The AMSAT Journal*. Your editorial and technical knowledge and skill enhance featured articles, especially those involving technical topics. Close support of the content and appearance of the articles improve the overall quality of the *Journal*.

Steve Kenwolf, WH6BSZ

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your imaginative and professional designs that have graced the AMSAT shirts and hats, as well as the banners and posters used at the new venue for the Dayton Hamvention.

JoAnne Maenpaa, K9JKM

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your hard work and dedication as a Weekly Editor of the AMSAT News Service in the publication of the weekly ANS Bulletins. The ANS Bulletin has significant worldwide reach and is highly regarded for the quality of publication. Thank you for your active participation in AMSAT's presence at the Dayton Hamvention and for your authorship and contribution to *Getting Started With Amateur Satellites*.

W. M. "Red" Willoughby, KC4LE

In Recognition of Your Outstanding Contributions to AMSAT User Services
Thank you for your continuing support and expertise as an Assistant Editor of *The AMSAT Journal*. Your editorship, suggested improvements and content generation, such as the "Chirps" column, as well as enhancing the appearance of the articles improve the quality of the *Journal*.

Paul Graveline, K1YUB

In Recognition of Your Outstanding Contributions to AMSAT User Services

Thank you for your support and expertise as an Assistant Editor of *The AMSAT Journal*. Within a relatively short time, your enthusiasm, content generation, and stepping forward as the primary administrator for handling the volunteer recognition process have made you a valuable member of the *Journal* and broader User Services teams.

Marty Smith, WV5Y

In Recognition of Your Outstanding Contributions to AMSAT User Services

With extreme dedication to promote amateur radio satellites you have hosted the Houston AMSAT Net in cooperation with Bruce Paige, KK5DO, and Andy Mac Allister, W5ACM , to provide weekly content around the world. Your net is available on RF, via the Internet, and via telephone and offers one of the most accessible and informative outlets to learn about the amateur satellite community.

Mike Young, WB8CXO

In Recognition of Your Outstanding Contributions to AMSAT User Service

Thank you for building and testing the LVB Trackers that we sell at the Dayton Hamvention and through the AMSAT Store. Your effort results in a significant source of income for AMSAT.

Symposium

Frank Kostelac, N7ZEV

In Recognition of Your Outstanding Contributions to the 2017 AMSAT Space Symposium and General Meeting

Thank you for your hard work and dedication as 2017 AMSAT Symposium Co-Chairman and as member of the Prize Committee. Your dedication and long hours have made this symposium a great success.

Robert Ludtke, K9MWM

In Recognition of Your Outstanding Contributions to the 2017 AMSAT Space Symposium and General Meeting

Thank you for your hard work and dedication as 2017 AMSAT Symposium Chairman of the Prize Committee. Your dedication and long hours have made this symposium a great success.

Susan Ludtke, N0DBY

In Recognition of Your Outstanding Contributions to the 2017 AMSAT Space Symposium and General Meeting

Thank you for your hard work and dedication as 2017 AMSAT Symposium Chair of the Registration Committee and member of the Prize Committee. Your dedication and long hours have made this symposium a great success.

Clark Wurzberger, KJ6SEL

In Recognition of Your Outstanding Contributions to the 2017 AMSAT Space Symposium and General Meeting

Thank you for your hard work and dedication as 2017 AMSAT Symposium Sargent At Arms. Your valuable advice and assistance to the 2017 Symposium Chairman at any hour of the day or night is greatly appreciated. Your dedication and long hours have made this symposium a great success.

AMATEUR RADIO IN SPACE
AMSAT®

The AMSAT Journal Needs Your Words and Wisdom

The AMSAT Journal is looking for interesting articles, experiences and photos to share with other AMSAT members. Writing for the *Journal* is an excellent way both to give back to the AMSAT community and to help others learn and grow in this most fascinating aspect of the amateur radio avocation.

Find a quiet place, sit yourself down, get out your laptop or pick up a pen, and ...

1. *Launch* your inner writer;
2. *Downlink* your knowledge and experiences to others by:
   - Sharing your adventures in the "On the Grids" column or
   - Describing your AMSAT career in "Member Footprints;"
3. *Transmit* lessons learned from operational and technical projects;
4. *Log* some of your more interesting passes across the sky; and
5. *Boost* others to a higher orbit of know-how and experience.

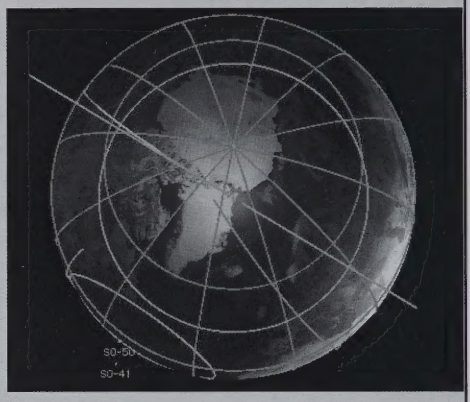
After your article lands in members' mailboxes, and the kudos start arriving for your narrative payload, you can enjoy the satisfaction of knowing you've elevated the collective wisdom of AMSAT to a higher trajectory.

Send your manuscripts and photos, or story ideas, to: **journal@amsat.org**.

Our editors are standing by!

MacDoppler

The premier Satellite tracking and station automation application for the Macintosh - OS 9 & OS X



MacDoppler for Cocoa gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to a fully automated Satellite Gateway!

It will calculate the position and relative velocity of the satellites you are tracking and automatically adjust the Doppler shift on both transmit and receive as well as pointing your antennas with predictive dead spot crossing so that a pass is never interrupted.

A Universal Binary that runs native on Intel and PPC Macs and provides separate panels for the map (2D or 3D), the radio and rotor controls, a sorted table of upcoming satellite passes and a Horizon panel that graphs upcoming passes as a function of elevation over time.

Now available from AMSAT at a special member discount donation!

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10605 Concord St. Suite 304
Kensington MD
20895-2526 USA.
(301) 822-4376, (301) 822-4371 (Fax)

Dog Park Software Ltd.
www.dogparksoftware.com

AMSAT Fox-1Cliff & Fox-1D $125,000 Launch Initiative Goal

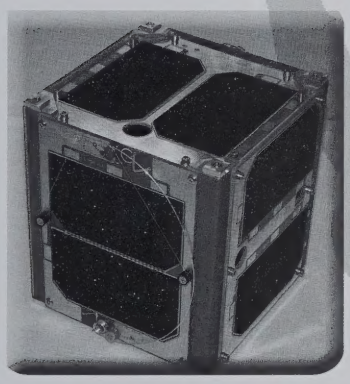
AMSAT is excited about the upcoming launch opportunities for the Fox-1Cliff and Fox-1D Cubesats. Fox-1Cliff and Fox-1D will provide selectable U/V or L/V repeater capabilities on separate frequencies once in orbit, and will be capable of downlinking Earth images from the Virginia Tech camera experiment.

AMSAT has an immediate need to raise funds to cover both the launch and related expenses for Fox-1Cliff and Fox-1D. We have set a fundraising goal of $125,000 to cover these expenses and help us to continue to keep amateur radio in space.

Fox-1Cliff will launch on Spaceflight's SSO-A dedicated rideshare mission aboard a SpaceX Falcon 9 scheduled to launch from Vandenberg Air Force Base in California in late 2017 or early 2018.

Fox-1D will ride to orbit on an Indian PSLV vehicle scheduled to launch from Satish Dhawan Space Centre in Sriharikota, India in late 2017.

Donations may be made through the AMSAT webpage at **www.amsat.org**, by calling (888) 322-6728 or by mail to the AMSAT office at 10605 Concord Street, Kensington, MD 20895, USA. Please consider a recurring, club, or corporate donation to maximize our chance of success with this mission.



Your help is needed to get the AMSAT Fox-1Cliff and Fox-1D 1U Cubesats launched.

For the latest news on Fox-1 watch our website at www.amsat.org, follow us on Twitter at "AMSAT", or on Facebook as "The Radio Amateur Satellite Corporation" for continuing news and opportunities for support.

AMSAT President's Club
Support Fox-1Cliff and Fox-1D

Contribute to AMSAT directly through easy, automatic charges to your credit card. Since AMSAT is a 501(C)(3) organization donations may be USA tax deductible. (Check with your tax advisor.) To join contact Martha at the AMSAT Office by phone (888) 322-6728 in the US, or (301) 822-4376; e-mail **martha@amsat.org**.

Titanium Donors contribute at least US $400 per month	❒	$400 / month
	❒	$4800 one time
Platinum Donors contribute at least US $200 per month	❒	$200 / month
	❒	$2400 one time
Gold Donors contribute at least US $100 per month	❒	$100 / month
	❒	$1200 one time
Silver Donors contribute at least US $50 per month	❒	$50 / month
	❒	$600 one time
Bronze Donors contribute at least US $25 per month	❒	$25 / month
	❒	$300 one time
Core Donors contribute at least US $10 per month	❒	$10 / month
	❒	$120 one time

AMSAT is Amateur Radio in Space ... and YOU are AMSAT!

Seize opportunities to launch your amateur radio experience to new heights!

ARISS Development and Support

AMSAT's Human Space Flight Team is looking for volunteers to help with development and support of the ARISS program:

- Mentors for school contacts
- Support for the ARISS web
- Hardware development for spaceflight and ground stations
- Help with QSL and awards certificate mailing.

To volunteer send an e-mail describing your area of expertise to Frank Bauer at: **ka3hdo@amsat.org.**

AMSAT Internet Presence

AMSAT's information technology team has immediate needs for volunteers to help with development and on-going support of our internet presence:

- Satellite status updating and reporting.
- Add/delete satellites to ANS and the web as needed.
- Research and report satellite details including frequencies, beacons, operating modes.
- Manage AMSAT's Facebook and Twitter presence.

To volunteer, send an e-mail to Drew Glasbrenner, KO4MA at: **ko4ma@amsat.org**.

AMSAT Engineering Team

AMSAT Engineering is looking for hams with experience in the following areas:

- Attitude Determination and Control, and Thermal Engineering, to help in the design of high orbit CubeSats.
- Power systems, for CubeSats from 1U through 6U and LEO to HEO.
- Help with solar, power supply, and battery design for both LEO and HEO missions.
- Logistics, for parts procurement, inventory, and distribution.
- Documentation, for designs, tests, and public relations.

To volunteer, please describe your expertise using the form at **www.amsat.org/contact-amsat-engineering/.**

AMSAT User Services

AMSAT is looking for an on-line store co-manager to update and refresh the AMSAT Store web page when new merchandise becomes available or prices and shipping costs change.

- Add new merchandise offerings
- Delete merchandise no longer available
- Update shipping costs as needed
- Add periodic updates for event registrations
- Interface with the AMSAT Office

To volunteer, send an e-mail to Joe Kornowski, KB6IGK at: **kb6igk@amsat.org**

AMSAT Educational Relations Team

AMSAT's Educational Relations Team needs volunteers with a background in education and classroom lesson development ...

- Engage the educational community through presentations of how we can assist teaching about space in the classroom.
- Create scientific and engineering experiments packaged for the classroom.
- Create methods to display and analyze experimental data received from Fox-1.

To volunteer send an e-mail describing your area of expertise to Joe Spier, K6WAO at: **k6wao@amsat.org**.

AMSAT Field Operations

AMSAT's Field Operations Team is looking for satellite operators to promote amateur radio in space with hands-on demonstrations and presentations.

- Promote AMSAT at hamfests
- Setup and operate satellite demonstrations at hamfests.
- Provide presentations at club meetings.
- Show amateur radio in space at Dayton, Pacificon, Orlando Hamcation.

To volunteer, send an e-mail to Gould Smith, WA4SXM at: **wa4sxm@amsat.org**

You can find more information on the web:
www.amsat.org – click AMSAT – then click Volunteer